The Science Teacher

DEVELOPED SILVER GRAINS IN NEW PHOTOGRAPHIC EMULSION SHOW "ELECTRON TRACK". *Courtesy Eastman Kodak Company.* (See page 111.)

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Official Journal of

National Science Teachers Association

Publication office: 201 North School Street, Normal, Illinois.

Editorial and Business Office: 201 North School Street, Normal, Illinois.

Office of National Science Teachers Association: 1201 16th Street, N. W., Washington, D. C.

Entered as second-class matter January 30, 1940, at the post office at Normal, Illinois, under the Act of March 3, 1879.

Subscription rates: In the United States, $1.50 per year; in Canada, $1.60 per year.

The Science Teacher

VOLUME XV | OCTOBER, 1948 | NUMBER 3

Outlook in Science Education*

MORRIS MEISTER

Principal, High School of Science
New York City

FOR THE past two years I have been privileged to serve the National Science Teachers Association. The experience has opened vistas of hope; it has also produced much discouragement. The hope comes when you train your sights upon science classrooms, pupils and teachers; the discouragement develops as you raise your sights to the higher echelons of supervisors, administrators and educationists. For at these higher strata you see men—so many of them very able—struggling with the mechanics of education, its organization and administration. Handicapped by budgets which are pitifully inadequate and by traditions that are fearfully potent, most of them move along paths of least resistance. They are quite ready to salute science as a new force in modern life; they are also too ready to avoid change in curriculum or in method. When they say: "This is administratively impossible", it is never quite clear whether they mean: "This is administratively inconvenient."

In still another stratum, where sit the educational philosophers and professors of education, one encounters a different sort of frustration. Rarely are they men who have been trained in science. So few of them have ever tasted the joy of putting a question to nature in the laboratory. They will declaim with the best of us, "This is an age of science," and then negate the implications with truly eloquent appeals for "more humanities and more social studies or our civilization will be destroyed." Not that anyone can or wishes to object to the humanities, social studies or civilization, yet few of them can see or will admit that science today *is* one of the humanities; or that science has given the social studies and civilization a new meaning. Deep down in their hearts, too many of our educational leaders really want to declare a holiday in science. Like the vast majority of mankind, they also fear and distrust science. They blame the horrors of war upon it, because they do not really understand. For example, when the nuclear physicist says, "There is no atomic secret . . . There is no defense against atom bombs . . . There can be no victory in atomic warfare," the physicist is offering a truth based upon a long line of evidence and is willing to act accordingly. The same ideas do not carry true conviction to the man-on-the-street or to the non-science trained educational leader. And the proof of this is in the fact that both continue to behave as they did in the past; both tend to make science the scapegoat for an uncomfortable world situation, created by man, not science.

As indicated before, a more hopeful outlook appears when you focus upon the grass-root teachers in science classrooms. The hope arises out of their very inadequacy to cope with the questions and basic interests of youth in solving the problems which face them. Teachers are trying; they are reading; they are seeking help. We have been amazed at the response of N.S.T.A. members to the Packet Service which is, after all, but a small effort to carry the latest and best literature from industry to the science teacher. How much more might be done if our textbooks, our equipment and our in-service courses were as modern and as up-to-date as the material which comes from industry!

One of the strange anomalies in the science education picture today is that we are a people almost illiterate in science, in a country that

*Address of the Retiring President of the National Science Teachers Association, Cleveland, July 5, 1948.

leads the world in technological development. Every one of us derives benefit from thousands of scientific applications; so few of us understand the ideas which underlie these applications. This condition cannot continue indefinitely and there are signs that it will not. Recognition of this anomalous situation is coming from the very highest places; from presidents of universities, from men like David Lilienthal, Dr. Conant, Dr. Shapley and others. A report from advisors to President Truman on Science and Public Policy takes occasion to emphasize the need for more and better science teaching for all. The conviction is spreading that if 90 per cent of our citizenry knew more about the workings of the human body, we would have a healthier community; that if 90 per cent of our people knew more about the crust of the earth, we would find it easier to conserve our dwindling natural resources; that if 90 per cent of all men and women were to understand better some of the facts of evolution and some of the principles of cultural development, there would be less prejudice and tension in the world. The time will come when science, like the three R's, will be accepted as basic to every individual's education.

"How can this possibly happen?" you will ask. How can we find the curricular time? Of course, this is a troublesome question. There are indications that some of the "water' in the curriculum will be squeezed out. Is it sacrilegious to say that there is much that can be omitted with profit? But most of the time will be saved by new orientations and integrations which will relate what is now *in* the curriculum to the science which gives it new and vital meaning. This process has happened in the past and will happen again. We see it emerging from teacher workshops and curriculum laboratories all over the country. Publishers will tell you that there has been an amazingly large sale of elementary science books in recent years. This heightened interest will have its effect upon the curriculum and will inevitably lead to greater teacher competence in utilizing science activities for the educational growth and development of children. The repercussions will be felt, in time, all the way up to the college.

An unfortunate retarding influence in this respect, however, is that science teachers as a group do not register their needs effectively with administrators and the public because they are often divided among themselves. They seem to be more interested in physics, in chemistry, in biology, in physiography, in geology, or in nature study than in science itself. Is it not too bad that the N.S.T.A. is on occasion suspicious of the N.A.B.T. and vice versa. Is it not unfortunate that the American Nature Study Society sometimes does not cooperate quite wholeheartedly with the National Council of Elementary Science and vice versa? Were all the science teachers genuinely united in a single strong national organization with one excellent magazine, their voice would be strong and irresistible.

Another intriguing fact that colors the outlook in science education is that good science teachers are too happy in their work. Too few of them want to become principals and superintendents. As a result, educational administration tends to lack adequate understanding of and a sympathetic attitude toward the problems of science teaching.

A rather distressing aspect of science teaching, especially in the junior and senior high schools, is that so many of these schools are too small. Because they are small, they can not afford all the needed variety of teaching talent and equipment. According to the most reliable data currently available, there are about 12 million boys and girls in junior and senior high schools. Three million of them are in schools with populations over 1,000. Two million are in schools with populations over 500. The remaining seven million are in schools with populations less than 500. I submit that the educational process can not possibly be the same for the seven million as for the five million; not in teacher talent, not in equipment, not in enrichment of curricular offering. Yet all of them are future citizens of our American democracy. They are the generation upon whom we must rely for the preservation of the American way of life. What is the answer? I do not know the entire answer, but part of the answer is that we must recognize the seriousness of the problem; we must consolidate our school populations wherever feasible; we must find new teaching procedures and new curriculum syn-

theses and work out new and better pre-service and in-service training for teachers. Perhaps the problem should be attacked with a two-track approach—one for the very small school and the other for the school of reasonable size.

But there is also a second order of difficulty. Every group of children that a teacher faces—in large or in small schools—presents a wide spread of native ability, interest and capacity to learn. So long as society can not afford a teacher for each individual pupil, we shall need to teach children in groups—anywhere from 25 to 35 in a group. Under such conditions, we usually try to pitch our efforts at the level of a mythical average child. This is seldom a good solution, because we are sure to lose the lower quartile and to offer no challenge to the upper quartile. Somehow, we must find ways of narrowing the range of abilities, interests and capacities. In the larger school systems and schools, it becomes possible to attempt segregation of ability groups. Wherever this has been tried, the results are phenomenally good. The stimulus of good minds upon other good minds produces amazing achievements, creative mindedness of a high order, heightened interests and a challenge to the limits of the pupil's capacity, without any loss whatever in the common attributes of character, humility and the democratic spirit.

In the small school, we must find ways of approximating some sort of equivalent. We can at least adopt a two-track system of science study. One track will lead in the tenth grade to a course in general biology, followed by another year, in grade eleven or twelve, of physical science. The second track will, as far as administratively possible, lead to biology, chemistry and physics in grades, ten, eleven and twelve. If practical difficulties make such a two-track solution impossible, and the outlook for this is still not good in many school situations—then the sequence: general science + general biology + physical science is a far more productive approach for most children, than the sequence: general science + biology + chemistry + physics—which so few get anyhow.

If one wishes to become really pessimistic about the outlook in science education, a look at the science teacher's teaching load will produce the desired effect. Granted that *all* teachers have too heavy a load for effective teaching and that there are some non-teaching duties that must be done by all of us on an equitable basis, it is still unfair to overlook the essential dependence of good science teaching upon adequate demonstration and laboratory equipment. In the junior and senior high school, the English teacher and the science teacher both teach about 25 periods a week; both have the same number of administrative assignments; both must prepare lesson plans; both have tests and papers to correct and conferences to attend. In addition, however, the science teacher must devise demonstrations, set them up, try them out, repair equipment, store it away and keep an inventory. If he is brave enough to do laboratory work, he doubles the chore at least one day a week. And if he is professional enough to run a science club, he triples the chore. Whichever way you look at it, the outlook here is bad. The science teacher's work-week is so heavy that there is little time for good science teaching. Too many of us—in sheer desperation—are adopting the "talkie-chalkie" method of science teaching; that is, like the English and social studies teacher, we deal more and more with verbalisms, using the blackboard for graphic demonstrations. As for individualized laboratory work, it is rapidly disappearing from the high school curriculum. And with it is going the most worth while contribution that science teaching can make to the lives of our children. I note with dismay that the 46th Yearbook on Science Teaching recommends the discontinuance of the double laboratory period. "This trend," it says, "is on the whole defensible and in most respects desirable." Thus, the yearbook makes a virtue out of a necessity; which to my way of thinking is neither a necessity nor a virtue. It is most significant in this connection to note the recent growth of science clubs, science fairs and science congresses. In a sense, this development is an escape mechanism for the good science teacher. He does his best science teaching there and on a voluntary basis. Why? Because those who join the club or do the

Continued on Page 132

This and That

NORMAN R. D. JONES
President, National Science Teachers Association

President's Message

Since your newly elected president has been conducting this column for some time, I shall bring you a brief message here.

I would like to pay tribute to the fine contributions made by my predecessors in this office, Dr. Philip G. Johnson and Dr. Morris Meister. They have worked and still are working unceasingly for the advancement of N.S.T.A. in its various activities. Also credit must be given to each and every officer and worker for N.S.T.A. for their excellent assistance given to the total N.S.T.A. program. Cooperation of all has been essential to bring about the splendid results of the past.

Likewise, in looking forward to the coming activities of N.S.T.A. your help will be even more essential to the continued success and advancement of the association.

Elsewhere in this issue you will note that N.S.T.A. has achieved a long time goal—a full time Executive Secretary, Mr. Robert H. Carleton. It is with great anticipation that we welcome him to this office.

Fall activities are well under way. Another great year is anticipated. It is my earnest hope that we will have the implicit cooperation of all of you, whether officer, leader, or member, in an attempt to make this an unprecedented year for N.S.T.A. Will each and every one of you join me in our endeavor to make the 1948-9 year a "banner" year?

News

Mr. W. B. Buckham, vice-president, western area, and Mr. Edward W. Long, director, Northern California, were N.S.T.A. delegates to the UNESCO conference in San Francisco last May.

Dr. Harold E. Wise, an N.S.T.A. director, who has served as chairman of several important committees, has received a nice promotion. September 1st he was elevated to the position of Assistant Dean of the Graduate College at the University of Nebraska.

Dr. Nathan A. Neal, our president elect, formerly director of station WBOE of the Cleveland schools, who completed the work on his doctorate at Columbia University this last year while doing part time editorial work for Harper and Brothers Publishers, accepted the editorship of the high school textbook department of that firm.

Miss Ruth Armstrong, a science teacher of Fort Smith, Arkansas and also president of the state department of the classroom teachers, is one of 25 selected to act as instructors in a teachers training center at Seoul, Korea. This is a work-shop sponsored by the War Department to give the Korean teacher the American democratic approach to education.

Dr. R. C. Evans of Cambridge, England, an N.S.T.A. member, attended the meeting of the International Union of Crystallography at Harvard University July 28, 1948. He is secretary of the organization.

Time for Renewals

This issue is our last copy of The Science Teacher on your 1947-48 membership. Since you will not want to miss your December copy nor the packets or other publications made available, please send in your $2.00 for your 1948-49 membership now.

Science Talent Search

Urge your students not to put off or delay the preparation of their projects for their entry in this worthy undertaking sponsored by Science Clubs of America.

New Affiliations

The science division of the Georgia Education Association under the able leadership of Mrs. Myrtie O'Steen Baker voted affiliation N.S.T.A. at its spring meeting.

New Directors

Miss Archie MacLean, science supervisor of the Los Angeles Public Schools, has replaced Mr. Marion Taggart who worked so faithfully in organizing the California Science Teachers Association, Southern Section.

Mr. Harry Pulver of Minneapolis has replaced Miss Thelma Sneed, who will no longer be in that area, since she is completing her work on her doctorate.

Joint Meeting

A. A. A. S. Science Teaching Societies, December 27-30

This year, for the first time, the major science teaching societies affiliated with the American Association for the Advancement of Science will hold a series of joint meetings.

The American Nature Study Society, the National Association of Biology Teachers, the National Science Teachers Association, and the Section on Education (Q) of the A.A.A.S. will meet December 27 through 30 in Washington with headquarters at the Washington and Willard Hotels.

The general theme for the sessions will be "Meeting the Needs of Society Through Science Education." Joint sessions will be held on the mornings of December 28, 29, and 30, in the Hall of Nations Room of the Hotel Washington. The special topics for these sessions are: December 28, a panel discussion on "The Science Curriculum at All Levels of Instruction"; December 29, a panel discussion on "Problems of Science Teacher Training"; and December 30, the Third Annual Junior Scientists' Assembly.

Separate business sessions of the officers and boards of directors of the sponsoring societies will be held on the evenings of December 27 and 28.

The societies will hold a joint dinner in the Hall of Nations Room of the Hotel Washington on the evening of December 29. At this dinner we shall hear briefly from the past presidents of the cooperating societies regarding the aims, objectives and programs of their respective organizations. There is also to be an address by a prominent and outstanding scientist or educator.

The separate societies will hold individual sessions in the afternoons.

On December 28th the program of the National Science Teachers Association will be sponsored by our recently formed advisory council on industry-science teaching relations. The December 29th session will be sponsored jointly by the section on education of the A. A. A. S. and the National Council of Elementary Science Teachers. On December 30, following the "Junior Scientists' Assembly," N.S.T.A. will hold a "Science Club and Science Fair Project Exhibit." This will be offered under the theme "Teaching Devices and Pupil Projects."

The American Nature Study Society's afternoon sessions are as follows: December 28, "Nature in Every Day Living" with Raymond Gregg, Roger T. Peterson, E. L. Palmer, and Lewis H. Babbitt as speakers; December 29, "Conservation Issues Today," a panel discussion with Devereux Butcher, Ira C. Gabrielson, William Vogt, Ruth Gilmore, and Howard Zahniser participating; December 30, "Nature Literature for Children" with Glenn O. Blough, Edith Patch, Dorothy Bennett, and Eva Gordon.

Other details of the total program are still in the process of formulation.

N.S.T.A. is planning to hold open house from 4:00 to 6:00 P. M. of December 28 at its headquarters office located in the N.E.A. building. This will provide an excellent opportunity to become better acquainted with the facilities and staff of our Washington office.

Each of the two headquarters hotels are holding 100 double rooms at rates of $8.00 to $13.00 per day at the Washington and $6.50 to $11.00 at the Willard. These hotels also hold 25 single rooms each at $4.50 to $7.50 per day at the Washington and $4.00 to $7.00 at the Willard. Applications for reservations should be mailed directly to these hotels. Where possible arrangements should be made with a fellow teacher in order that a double room may be requested. Your reservation request *must* indicate your plans to attend the meetings of the *A.A.A.S. Science Teaching Societies*. The headquarters hotels are located in the same block and may be addressed as follows:

Hotel Washington, Pennsylvania Avenue at 15th Street, Washington, D. C.

The Willard, Washington 4, D. C.

Questions concerning the programs can be directed to the Program Committee—Dr. Richard L. Weaver, P. O. Box 1078, Chapel Hill, North Carolina, for the American Nature

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Robert H. Carleton

New Executive Secretary, N.S.T.A.

ROBERT Howard Carleton, assistant professor of physical science at Michigan State College, has been selected as the executive secretary of the National Science Teachers Association. He will be in charge of the headquarters office in Washington, D. C., and will undertake such field duties as may be advisable. His service began September 1.

Mr. Carleton was born in Dayton, Ohio, and is now in his 39th year. (In case you send birthday cards, the date was January 23.) His public school training was in Dayton. His parents, Guy and Lena Carleton, still reside in that city. He received his bachelor's degree from Ohio State University in 1930, his master's degree from New York University in 1945. He has been working toward his doctor's degree at Michigan State College. His undergraduate major was chemistry, his minors, physics and biology. His graduate work has been in science education. He has studied for special purposes at Teachers College, Columbia University, and Rutgers University. He is a member of Phi Beta Kappa and Phi Delta Kappa.

It is interesting to note that Mr. Carleton paid part of his college expenses by "magic shows" he gave in the neighborhood theaters of Columbus, Ohio. He has also had the standard employment experiences of working in restaurants and of setting up demonstration equipment for his professors.

Mr. Carleton's first teaching experience, in the Roosevelt High School of Dayton, was in the nature of an endurance contest. His schedule called for instruction in general science in grades 7, 8, and 9; physiology and physiography in grade 10; and chemistry in grade 11. He taught in Dayton for five years, in Madison, N. J., for one year, and finally in Summit, N. J., for ten years. He taught chemistry, physics, general physical science, and radio. Administrative responsibilities were assigned to him in due time, and he became head of the high school science department, chairman for visual education, and chairman for science education for all twelve grades of the Summit public schools.

Robert H. Carleton, new Executive Secretary, National Science Teachers Association.

Mr. Carleton has taught adults, too, at various times during his career. He was part-time instructor in general physical science in New York University; assistant professor of chemistry in Newark (N. J.) College of Engineering; assistant professor of physical science at Michigan State College. During the war years he taught in the Adult Evening School of Summit, N. J., offering courses in the fundamentals of radio, fundamentals of machines, and meteorology.

MR. CARLETON has been a prolific author. With others, he has produced six text books in general science, chemistry, and physics. Alone, he has been the author of four texts, including *Chemistry for the New Age*, which is in press. He has written four articles for *The Science Counselor*, three for *Science Education;* he has contributed chapters of the *Forty-Sixth Yearbook* (National Society for the Study of Education) and the *Report on Science Course Content and Teaching Apparatus.*

Mr. Carleton is a member of several scientific organizations. He was particularly active in the New Jersey Science Teachers Asso-

ciation, having served as chairman of the Chemistry Section, and corresponding secretary-treasurer for several terms. While quite a young science teacher he joined the Department of Science Instruction, National Education Association, and he has been a member of its successor, the National Science Teachers Association, since its organization. He served the N.S.T.A. as eastern vice-president for a term, was chairman of the committee on affiliated groups for two terms, was a member or chairman of the nominations committee for three terms. He was elected to the Board of Directors for a three-year term, beginning August 1, 1948.

OTHER professional activities of Mr. Carleton include service as president of the Summit (N. J.) Teachers Association for two years, and representation on the Council of Social Agencies in Summit for two terms. He promoted the organization of a Lay Advisory Committee on Educational Problems in Summit in 1943, which is still functioning. He belongs to the American Association of University Professors, and is a Mason.

In 1938 Mr. Carleton married Miss Dorothy E. Johnson of Montevideo, Minnesota. The family now consists of Nancy Eleanor, aged 8, Sally Jean, aged 6, and Guy Henry, aged 3. The hobbies of the Carleton family are modestly stated as bridge and good music in the winter, fishing and home gardening in the summer.

In his post as executive secretary of the National Science Teachers Association, Mr. Carleton will assume several promotional activities formerly carried out by various officers of the Association. His associate, Miss Bertha E. Slye, will continue as director of membership service, with special responsibility for the *Packets*. Elbert C. Weaver of Andover, Mass., will continue his duties as treasurer; Hanor A. Webb of Nashville, Tenn., will become recording secretary. Programs will continue to be the chief responsibility of the general vice-president, Ralph W. Lefler of Lafayette, Ind. The retiring president, Morris Meister of New York City, is serving a three-year term as chairman of the Advisory Council on Industry-Science Teaching Relationships. Broad matters of policy will rest on the decisions of the board of directors, headed by the president, Norman R. D. Jones of Saint Louis, Mo.

The headquarters office of the National Science Teachers Association is in the National Education Association's office building in Washington, D. C. The new officer of the association may be addressed as Robert H. Carleton, Executive Secretary, National Science Teachers Association, 1201 Sixteenth Street N. W., Washington 6, D. C.

Our Frontispiece

The path followed by an electron through a photographic emulsion is shown by our frontispiece. The developed grains of silver struck by the electron are enclosed by the arrow outline.

By means of a new photographic emulsion produced by the Eastman Kodak Company "electron tracks" have been successfully recorded. The number of developed silver grains per track in the emulsion ranges from six to a maximum of twenty-eight. The length of the path in the emulsion is about two thousandths of an inch—two-thirds the thickness of an average sheet of paper.

Here is how the electron tracks on the emulsion are obtained in the Kodak experiments:

X-rays are directed toward the emulsion through a sheet of lead. Passing through the lead filter, the x-rays knock loose secondary photo-electrons. When one of the flying electrons speeds into the emulsion, it strikes and affects silver grains electrically, and, a dotted line of the affected silver grains is produced. These silver grains, when the plate is developed, make an identifiable track. This is the path of the electron through the emulsion.

From the length and curvature of the track and the grain-spacing along it, information is obtained of the electron's speed and other characteristics.

Tracks may also be obtained from any radioactive substance which emits beta rays or streams of electrons.

Simplicity in Demonstrating Physics

RICHARD M. SUTTON

Chairman, Department of Physics
Haverford College

THE THIRD vapor pressure experiment consists in "making water run up hill". I have here a two-liter spherical flask containing only a few teaspoonsful of boiling water. The flask is filled with water vapor at atmospheric pressure, and most of the air has been driven out by the vapor. Now, if I close the flask with this single hole stopper and long glass tube, you may see steam emerging from the top of the tube. We will now invert the flask and tube, inserting the open end of the tube into this large beaker of colored water. You see water slowly rising in the tube, but you haven't seen anything yet! (Fig. 4.) Wait until the water reaches the flask. Then the cold water condenses the vapor in the flask and there is a sudden reduction of pressure. Atmospheric pressure rapidly drives the water from the beaker into the flask and the flask "sucks the beaker dry". You have just seen four pounds of water raised five feet "by its own bootstraps". Where did those 20 foot-pounds of energy come from?

Fig. 4. Water is here seen rising through a tube to fill a partial vacuum produced by condensing steam in the flask.

Moral: "Boiling, like many other common phenomena, is worth studying closely." You may recognize in this experiment an inversion of the modern coffee maker that "sucks" hot water down from one compartment to another. This vapor pressure "engine" is not unlike Newcomen's first steam engine. It stresses the strong dependence of vapor pressure on temperature.

Demonstration experiments are meant chiefly to acquaint the student with phenomena. They should be made so that *students* can see what is going on. They should invite the student's active interest and participation. Occasionally they may be made quantitative, or the basis for interesting problems. They should stress operational procedures: physics in action. They should clarify and not obscure. They should utilize the element of surprise wherever possible. Occasionally, they may take the form of a hoax or "nature faking", just to keep students wide awake and looking for false as well as true applications of principles. They should make principles emphatic by contrast and paradox. Above all, they must be presented in a fresh and active manner. No experiment is commonplace, and none should be shown in an apologetic manner.

Finally, omitting the description of several experiments for want of space, let us turn to three or four that relate to atomic phenomena.

WE MIGHT return to the rubber ball on the end of the string to make a crude picture of Bohr's model of the hydrogen atom. This white ball at the center now represents the proton, and the red ball the electron revolving (?) about it. (Do not take the color scheme too seriously). The various stable energy levels of hydrogen could be represented by the electron revolving at various distances from the nucleus, distances that are under control by the connecting string. In this case, the "attraction" due to electro-static

forces within the atom must be supplied by the operator.

Now, if you prefer to represent the helium atom with *two* electrons, here is a neat mechanical trick. These two tennis balls revolve

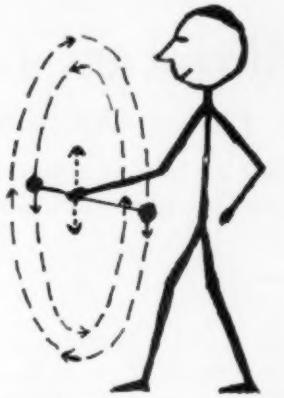


Fig. 5. Two tennis balls are made to revolve in opposite directions by a simple motion of the hands, illustrating the motion of electrons in the helium atom.

in opposite directions in a motion that is maintained by the straight up-and-down motion of my hand. (Fig. 5.) A single reciprocating motion perpetuates two circular motions in opposite directions! On one occasion when I was showing this, one of the strings broke and the tennis ball went flying across the room. It was obviously a case of "ionization" by an invisible influence, as I remarked at the time.

Moral: "Take advantage of unexpected turns in experiments. What happens is what *should* happen, even though it may not be what you looked for." If you capitalize on accidents and don't let them disturb you, they may be turned to good use.

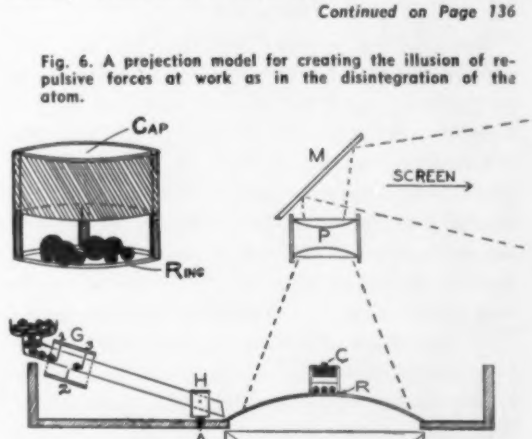
HERE IS A projection model for showing nuclear disintegration to a large audience. It was constructed several years ago (1934) before atomic physics had become of such interest to the general public. It makes use of a gravitational field instead of an electric field to produce the illusion of repulsive forces at work (Fig. 6.) The analogy is sufficiently close to make this more than just a fake of natural phenomena. On the screen you see a dark spot at the center of the illuminated field. That represents the nucleus of an atom, but on the scale of representation the electrons would be about 10 miles away. Now, suppose we start bombarding the nucleus with alpha particles or protons. Because of the positive charges on each, they are repelled by the nucleus, as shown by their curved paths veering away from it. But if we use faster particles, we finally reach a speed at which the impinging particles can "make the grade" and we may expect to produce some interesting nuclear transformations. Ah, yes! There was a capture. And another! Our nucleus is evidently getting heavier and probably unstable. Let's see. That time, one particle dashed in and two dashed out in different directions! And that time, the incoming particle was sharply deflected but not captured. And now, if I open the nucleus to your view, you see that it has an internal structure!

Moral: "Mechanical models to picture invisible events or abstruse concepts are a fair means of getting difficult ideas across." But the models should be reasonably close analogues of the physical situation, and it should not be forgotten that they *are not* the real thing, but only a crude representation of nature. Even our language and mathematics are still crude tools for telling us accurately about some of the most important parts of nature.

ATOMIC bombs are lots of fun, if they aren't used to blow up cities. Here is one that is quite harmless but instructive. Its atoms are ordinary mousetraps, but since these are "uranium mousetraps", they are provided with some neutrons in the form of two or three ordinary corks laid on each set trap. About four

Continued on Page 136

Fig. 6. A projection model for creating the illusion of repulsive forces at work as in the disintegration of the atom.



Science for Society

Edited by JOSEPH SINGERMAN

• A department in which science is presented in its close relationship to the individual and in which guidance is given in causing the individual to recognize the methods of science and its vast social implications.

Critical Thinking in the Use of Alcohol and Tobacco

MARIE ELINA CHERBONNIER

Head of Science Department
Newman School, New Orleans, La.

Sermons Prove Useless

It is absolutely useless to attempt the study of alcohol and tobacco with a group of adolescents in a high school biology class by a series of sermons on the evil effects. The adolescent is conditioned against preaching. But, after using a new method, which I shall describe, one student summed up the attitude of his generation when he wrote, "I liked this unit because the student was allowed to arrive at his own conclusions. He did not have the feeling of 'oh, that's just so much bull" from the teacher or textbook."

It is admitted that the development of the scientific method is the primary objective of any science course. Where is there a more fertile field for the devlopment of that attitude than in the study of the use of substances with which students come in contact every day? Thus, a few years ago two units were planned and carried out: one, "The Development of Critical Thinking in the Use of Alcohol and Tobacco;" the other, "The Analysis of Advertisements and the Use of Patent Medicines and Cosmetics."

Pre-Test

Because the teacher felt that the students already had fixed opinions and information on the subjects to be covered and because she wished to measure any change in opinion and information acquired through the study, a preliminary test or survey, prepared by the teacher, was given to the students. They were asked to answer the questions and candidly express their opinions. They were told not to sign their names. Typical questions were: "Do you think drinking morally evil? Can two ounces of alcohol harm the body? Is the before dinner cocktail a healthful innovation? Why are parties at which alcohol is served usually livelier than others? Would you, if a parent, give your teen-ager permission to drink a cocktail or two? Does alcohol affect reaction time?

"Do you smoke? Would you give your child permission to smoke? If so, at what age? Are the lungs and respiratory organs affected by smoking? Does tobacco affect the heartbeat, or the digestive organs? Does smoking relieve nervousness? Does smoking affect the marks of a high school student?"

The interest of the students was so aroused after the survey, no further motivation was necessary. They were ready to plunge into the study. This was something vital to them —immediately.

Reliability of Literature Considered

The teacher had collected literature on alcohol and tobacco from the *American Medical Association, Yale University Studies on Alcohol, Hygeia, Consumer's Research*, the temperance unions, textbooks, and by consultation with outstanding medical authorities in the city. The literature covered the physiological, psychological and sociological effects of alcohol in quantity and in moderation, and the effects of tobacco upon the adolescent, the adult, and persons suffering from chronic ailments. (Most of this literature is available free of charge or at a very small price.) The books, pamphlets, and articles were placed before the class, and each student chose one that he read, analyzed, and presented for discussion.

Since part of the analysis of an article is the reliability of the source, each student opened his report with a statement of the "credentials" of the author. Was he an

authority? Would he be in a position to give scientific facts? Interesting discussions occurred, particularly in the case of articles which gave little or no basis for the reliability of the author. Very often it was in these articles that sweeping conclusions were made about the detrimental effects of alcohol and tobacco. Students recognized the difference in the approach of the various articles and determined whether they contained scientific facts or whether they were merely appealing to the emotions. The students were not impressed with emotional articles. They challenged given experiments. In cases of two carefully performed experiments to show that scholarship is lowered by smoking, the students would not accept the conclusions on the basis of insufficient evidence. The sample was too small for such a general statement. They discussed how a more reliable experiment could be performed using larger groups in larger areas of the country. (It must be noted that at no time during the discussions did the teacher voice her opinions—a hard task for one who likes the sound of her own voice).

The actual laboratory work in this type of study cannot be as successful as might be desired. Each student was asked to plan an experiment that would demonstrate in the laboratory the effects of alcohol and tobacco. Some of them were very clever but obviously not suitable for the classroom. Students were allowed to smoke cigarettes and their pulse rate noted before and after the cigarette. The usual experiments given in the textbooks were performed, but these are not always completely reliable.

Changed Opinions

Following the study the same survey or questionnaire was given to the students to determine any differences in opinion and information. It is interesting that in the first test 88 per cent would give their "teen-agers" permission to smoke, whereas after the study only 56 per cent would. There were wide differences in the two tests as to the harm done by tobacco to the digestive organs, increase in heart beat, and effect on reaction time and school marks. In the case of alcohol, 8 per cent of the students believed drinking morally evil. Their opinions changed considerably as to the effects of alcohol as a body-warmer, as a stimulant, and as to its effects on reaction time. In the first survey 79 per cent would give permission to a high school "teen-ager" to drink a cocktail or two, whereas only four per cent would do so in the second test.

Even more interesting to the teacher than the actual statistics of the questionnaire were the students' candid opinions of this type of study after the unit was completed. The following are typical:

"It gives us a chance to say what we think."

"This study has given us the views of many groups, making us think and evaluate each one."

"This puts theory into practice."

"I've learned about the evils of smoking, but, even so, I won't give it up."

"Since drinking can't be stopped at some of the dances, maybe some of the facts learned in the biology class might scare some of the students out of it."

"A lot of problems caused by tobacco and alcohol would be solved if this sort of study could be given in all high schools."

"We try to tell our friends what we have learned, but they won't believe us."

It would be almost impossible to exaggerate the response which this unit on tobacco and alcohol, and its follow-up on cosmetics and advertisements, received. The "teen-ager" can think, and likes to think provided he is thinking about something in which he is interested. The teacher felt, from this study, that the student began to learn to discriminate among the things that he sees on the printed page. He learns to look for reliable authority, and to withhold judgment until he has sufficient evidence. He recognizes the difference in an assumption and a fact. Moreover, he learns that the scientific method is not just something to be used in the classroom but a way of thinking—to solve social as well as laboratory problems. One of the first questions new biology classes ask is, "When are we going to study alcohol and tobacco?"

Some Lecture Demonstrations*

FREDERIC B. DUTTON
Michigan State College
Lansing, Michigan

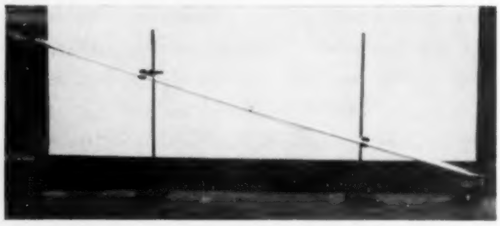
Lecture demonstrations are rarely the unique contribution of the demonstrator but rather the result of the accumulated experience of many persons. Consequently for the following series of demonstrations no claim is made for originality, except by way of modification, and in the main it is impossible to trace them back to their originators. Several have been published elsewhere.

1. Kindling temperature, the density of some vapors, and the dangers involved in handling such materials are illustrated as follows: Two or three lengths of 25 mm glass tubing are supported with ringstands and clamps so that they form a long inclined glass pipe (Fig. 1). The lower end rests on a hot plate or inverted flat iron. The joints may be sealed with cellulose tape. A dropper full of carbon disulfide (2 or 3 ml) is introduced at the upper end and the course of the liquid down the tube followed with a pointer. There is usually insufficient liquid to reach the lower end of the tube but in any event the vapors reach the hot plate first, and ignite, the flame progressing up the tube with accelerating velocity. This procedure necessitates a repetition so that the spectators may watch the hot plate for the ignition which they missed the first time. A little carbon disulfide on a cotton swab will serve to remove the sulfur which is deposited along the tubes.

2. One of the most effective lecture room appurtenances is a light box constructed of such dimensions that it will house a twin fluorescent light unit. It is covered with a sheet of opal glass (Fig. 2). At Michigan State College we plan the use of two of these units one built into the lecture table and flush with the top and a second unit which may be placed on top of the table and behind the various beakers and flasks to make the contents readily visible throughout a large lecture room.

*Presented before a joint session of the Cooperative Committee on Science Teaching of the A.A.A.S. and the National Science Teachers Association at Chicago, Illinois, December 29, 1947.

Fig. 1. Carbon disulfide vapors filling the glass tube are ignited by means of an electric hotplate. The flame travels up the tube with accelerating velocity.



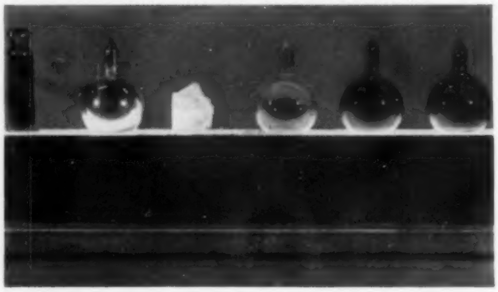


Fig. 2. A light box containing a fluorescent light unit serves to make the contents of beakers and flasks distinctly visible.

3. The labor involved in lecture preparation is greatly reduced if as many demonstrations as possible are prepared in permanent form and retained as a unit. To this end we have sealed off in glass flasks samples of the halogens and sodium which, when accompanied by a good-sized sample of rock salt (Fig. 2) serve to emphasize the distinction to be made between the elements and their ions. It is necessary to heat the flask containing the iodine to obtain sufficient vapor to yield an intense color. The flask containing sodium is in reality a sodium mirror. A cubic centimeter of clean sodium introduced into the flask is ample to yield a good mirror upon heating after evacuation[1].

We have found it useful to add to our permanent collection on the halogens cylinders of iodine in a non polar solvent (carbon tetrachloride) and a polar solvent (water containing a little potassium iodide) yielding violet

1—The technique for obtaining clean sodium has been described by W. C. Fernelius and Iman Schurman, *J. Chem. Ed.*, *6*, 1765, (1929).

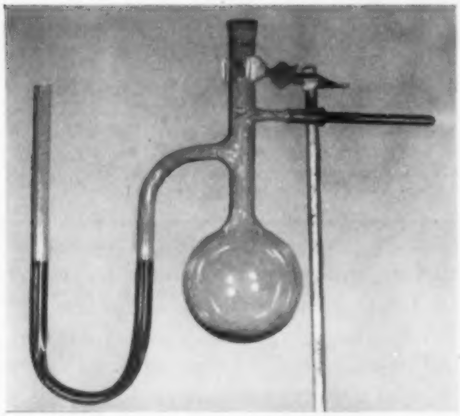


Fig. 3. Apparatus for demonstrating Dalton's law of partial pressures.

and brown solutions respectively.

4. Boyles' law is conveniently illustrated by an apparatus previously described[2]. It consists of four 1 liter flasks and a manometer connected in series. Evacuation of the system demonstrates atmospheric pressure. Upon admission of air we have a system of four liters of gas at one atmosphere pressure and $PV = 1 \times 4 = 4$. Disconnecting the vacuum pump or aspirator, connecting to the water faucet, and admitting water to fill the first flask forces the air into the other three with an increase of 1/3 of an atmosphere of pressure. We now have a system of three liters volume and 1 1/3 atmospheres pressure and $PV = 1\,1/3 \times 3 = 4$. Filling the second flask increases the pressure to 2 atmospheres and we have 2 liters under 2 atmospheres pressure and $PV = 2 \times 2 = 4$. This assumes of course that we are dealing with ideal gases and that the volume of the connecting tubing is negligible. Refined measurements would, of course, indicate the deviations from the perfect gas law.

5. Dalton's law of partial pressures may be demonstrated with the aid of the following apparatus (Fig. 3). A one-liter flask with two side arms is connected to a manometer and a trigger arrangement which, until rotated, will support a small sealed ampoule of ether. A suitable colored solution is used to fill the manometer. When the ampoule is dropped, it breaks, adding the ether vapor to the pressure of the air already within the flask and causing a rise of liquid in the open end of the manometer, thus indicating the increase of pressure.

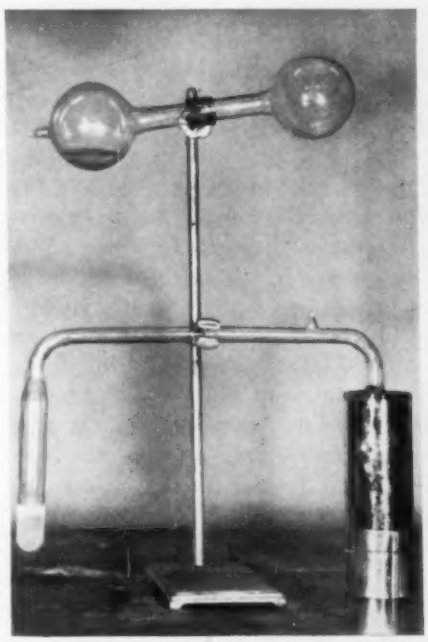
6. The cryophorous has largely disappeared from the apparatus catalogs. It is a very useful instrument to demonstrate change of state. Two varieties are suggested (Fig. 4). Two ampoules made from 25 x 200 mm test tubes are connected by glass tubing. Ether is introduced until about two inches deep in each tube. The system is connected by means of a side arm to the aspirator until about half the ether has boiled off, sweeping the air with it. The system is then sealed off. After pouring the ether all into one ampoule, the empty ampoule is immersed in a container of Dry Ice and acetone. The ether boils rapidly and its ampoule is soon coated with a thick coating of frost. This furnishes a focus for an extended discussion of change of state, heat of vaporization, the mechanical refrigerator, and the steam-heating system[3].

The design of the second device is due to Dr. Ross Baker of City College of New York

Continued on Page 130

2—F. B. Dutton, *J. Chem. Ed.*, *18*, 15, (1941).
3—F. B. Dutton loc. cit.

Fig. 4. Heat of vaporization and the operation of the mechanical refrigerator may be studied by means of this apparatus.



Audio-Visual Aids

Edited by CHARLES R. CRAKES

The editor of this department will attempt to bring before the readers of this publication the latest articles written by science teachers who are making effective use of various forms of audio-visual teaching materials. He will also endeavor to present a cross-section of educational opinions on audio-visual aids he may gather in travelling about North America.

New Films

Recently your editor previewed several very fine science films. The first, *The Nature of Light*, produced by Coronet Films, Coronet Building, Chicago, Illinois, has as collaborator, Dr. Ira M. Freeman, Associate Professor of Physics, Swarthmore College. The film requires ten minutes to run and is evaluated as for junior and senior high school grade levels.

The film shows students how much they can learn about properties of light simply by observing the world about them. Two boys on a fishing trip study light to learn that it is a form of radiant energy that is reflected and refracted. With the aid of a camera they brought along, they also learn about the focus of a lens and other optic principles.

The second film, *The Nature of Sound*, by the same producer and collaborator as listed above, also requires ten minutes to run. An evaluation indicates it meets requirements of junior and senior high school grade levels. This film teaches with sound—illustrated, animated, and in motion—giving students a bright, new understanding of the principles involved in the production and transmission of sound and a knowledge of its characteristics.

The third film, *Fungus Plants*, produced by Encyclopaedia Britannica Films, Wilmette, Illinois, requires ten minutes to run and is evaluated as for high school botany classes. This film shows the story of mushrooms and other fungi. The toadstool, puffball, and several other kinds of fungi and molds are illustrated in striking close-ups. The shaggy mane, gilled and edible types of mushrooms are described and pictured, with animated sequences showing the intricate structure of the gills. Photomicrographic studies are presented to clarify the structure of spores and to depict the streaming of protoplasm in the filaments. The rapid growth of various fungi is illustrated by means of time-lapse photography.

A fourth film by the same producer, entitled *Atomic Energy* will prove of unusual interest to high school, college, and adult groups. This film requires ten minutes to run. It consists almost entirely of animated drawings, and illustrates the known facts about the nature of atomic energy. It shows the general structure of atoms, and tells how atoms of one kind can be transformed into another, releasing energy in the process. It explains the differences between radiant energy, chemical energy, and atomic energy, and elaborates upon the three known forms of atomic energy, which are nuclear synthesis, as in the sun; natural radioactivity, as an radium; and nuclear fission, as in the atomic bomb.

The fifth film entitled the *Life Cycle of a Mosquito* produced by Young America Films, Inc., 18 E. 41st St., New York 17, New York, should be excellent for high school and college science classes. The film is 12 minutes in length and describes the life cycle, structure, and feeding habits of the mosquito. The opening scene illustrates characteristic feeding positions of the *Anophiline* and *Culicine* mosquitoes. Live action plus animation is used to show the anatomy of the mosquito. Photomicrographic scenes deal in detail with the mosquito egg, the larval and pupal case.

Mr. William F. Dresia, the author of the interesting article entitled "Science Is Fun", is director of audio-visual aids in the high school at San Raphael, California. He received his bachelor's degree from the University of Oklahoma where he majored in chemistry, and master's degree from Stanford University. After a year of post graduate work in Germany he began the teaching of science in the schools of California. As early as 1935

he was producing school-made documentary and training films in southern California. During the summer of 1947 he returned to Stanford as an Encyclopaedia Britannica Film scholar and carried on research work directed towards the problems involved in expanding the audio-visual program of the San Raphael schools.

Readers interested in the complete list of films utilized by Mr. Dresia and his science class may secure it by directing an inquiry to him at the San Raphael High Scholo.

The editor has compiled a mimeographed list of science teaching films (As of November, 1947) showing name of producer and address, name of film, length, and evaluation as to whether each film will prove most effective on the elementary or secondary grade levels. A copy will be sent any reader requesting it.

Science is Fun

WILLIAM F. DRESIA

San Rafael High School
San Rafael, California

IN SAN RAFAEL, the students have fun studying general science. They take their fun seriously, too. Here the general science teachers use visual aids as the core of the course, the text-book being supplemental. The students enjoy the films and demonstrations, but take them with the same serious oulook they would a text-book; indeed, much more seriously than some students are inclined to take text-books. This is evidenced by the rustle of the "study sheets" as soon as the lights go on.

These general science students are unselected and heterogeneous, so one immediately discards all ambition of making scientists of most of them. Why should they be taking a science course? We believe that the greatest value to the student lies in acquainting him with the fields of science, stirring his interests, and challenging him with some of the broad problems of science.

The general science program must be carried on discreetly lest the means defeat the ends. In most schools, general science is apt to be a "book course" combined with a demonstration now and then by the teacher. Particular emphasis is likely to be placed upon topics of most interest to the teacher. Lack of time, laboratory space and equipment generally preclude much pupil participation. Under these conditions the motion picture is a great tool for providing vicarious experiences for the student.

Good films in nearly all fields of science are now available or are becoming so. Strip films and slides provide excellent reinforcements.

THE GENERAL science course in San Rafael is frankly designed as an exploratory and interest provoking experience. We believe that the best interest of the great majority of present day public school students are thus served.

A series of motion pictures, filmstrips, slides and demonstrations is selected to follow the broad outlines of the text-book. The subject to be studied may be introduced in any one of several different ways. Sometimes the film may lead off as a general interest stirring medium. Again, perhaps a demonstration or a magazine article may serve to start thought along the desired lines. Much depends upon the type of material available and the subject itself. Films which are somewhat technical in nature are not essayed until some groundwork has been laid.

When our classes are ready to study sound and acoustics, the instructor laid the foundation by a series of demonstrations. When the class members assembled, they saw before them an intriguing array of such marvels as tuning forks, whistles, sound disks, a flute, a sonometer, an organ pipe, resonance tubes, a long spiral metal spring and even a few bars from a small xylophone. Curiosity ran rampant. Front row seats were at a premium.

During the course of the demonstration, a lot of unfamiliar words were used and written on the blackboard. Before long, students

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Science Clubs at Work

Edited by MARGARET E. PATTERSON
Secretary, Science Clubs of America

• A department devoted to the recognition of the splendid work being done by science club members and their sponsors. Material for this department, such as student made projects; demonstrations and posters; outstanding club programs; state and regional meeting announcements; should be sent to Miss Patterson, Science Clubs of America, 1719 N Street, N. W., Washington 6, D. C.

A Club Hobby Can Become a Class Activity

MARY M. HAWKES

High School, Hood River, Oregon

CLUB HOBBIES sometimes grow into classroom activities. The development of our Camera Club in the Hood River (Oregon) High School is an example of such a situation.

The club, originally started in 1945-46 for a few boys seeking a photography dark room, began in the chemistry laboratory. During that year some business and activity meetings were held for the 15 active members and a few prints were produced for the yearbook.

The second year, 1946-47, hot dog sales at games made possible the purchase of a small enlarger and two home-made contact print boxes—equipment worth about 80 dollars. During each regular meeting a demonstration of some photographic technique was featured; afterward some of the 55 members taught these photographic procedures to newer members. The dark room was scheduled for every school and after school hour as individuals practiced their new knowledge. The club ordered quantity film and contact paper, difficult to procure at the time, and retailed it to individuals according to plans and rates agreed upon by the members. The fee per member of 25 cents covered the cost of teaching new members.

A student is preparing to take a picture for use in advertising. Many pictures are taken for use on Christmas cards.

ABOUT SIX evening meetings were held during this second year, with a local photographer sometimes invited as the speaker. Meetings for business were called as needed during our weekly school activity period or at noon. After sponsoring an all-school dance and a dance at a carnival, we realized many of our members were interested in the social side of the club only, so we decided to drop that phase entirely and thereby keep the membership smaller and more active. Throughout the year the members accomplished a great deal of contact printing and enlarging for themselves. A few enterprising members also made montages for yearbook division pages.

Third Year of Club Activity

The club members took most of the pictures used in the yearbook for 1947-48, the third year of our club activity. A good camera, adequate enlarger and various items of incidental equipment, amounting to $560, were purchased through a loan from the Student Activity Fund; about three-fifths of this loan was repaid the same year.

To cut down on equipment expense the boys made print boxes in the woodworking shop.

Here a number of shop-made print boxes are at work turning out pictures for use about school and for sale.

We now have seven shop-made print boxes, a home-made enlarger, and an excellent timer designed by a boy interested in electricity. The camera, tripod, and our four enlargers are our most expensive items.

Camera Club Grows Into a Class

FOR THE ambitious project of yearbook pictures, extra time was needed, so in its third year the club work expanded into a regular class subject with credit given toward graduation. It is difficult to separate the work of the class from that of the club as each one contributes to the other. The 14 photography class members are also members of the Camera Club. The class makes full use of the club equipment and in large measure is responsible for earning its money through yearbook pictures and individual orders. The club holds business meetings twice a month at noon or during activity periods and has two evening meetings per month, when learning sessions are mingled with visits from photographic hobbyists.

The club meetings are planned and directed by the officers and the program committee; money earning activities and purchase of equipment are planned and directed by a purchasing committee. The sponsor assists both. All funds are handled through student activity accounts and all purchases are by requisition.

Club Makes Money

The 43 Camera Club members have been active in earning money. Food and cold drink sales at games have netted much needed fund At the school carnival the club set up a studio booth and did a rushing business in pictures which were finished and mailed out the following week. Before Christmas the club printed and sold about 40 dozen photographic Christmas cards. The club takes good quality amateur pictures for use in the yearbook; retakes can be arranged during school hours.

When the band and senior play cast wanted photos for advertising and the Carnival Princesses' photos were needed for display, the club was called into action. A few of their pictures have appeared in the weekly Hood River papers and they cooperated with the local civic music association by taking many pictures during their practice sessions. Members have contributed to local and national photographic contests and have completed portraits (sometimes tinted) on order from teachers and students. A complete set of newspaper and yearbook activities of our school was supplied to the State Department, Washington, D. C., as requested in connection with a program of education abroad. The last order filled this year was for 93 enlargements of our photo of the Junior High School Band. Two exhibits were prepared during the year: one at the request of the mothers; another for the Girls' League. The money-making opportunities are increasing along with the club's experience.

A few students have been able to work up quite a little business of their own by going to homes to take pictures—the baby, a party,

A photographic print is being developed. Note that the tray for washing is conveniently arranged in the sink so running water may be used.

A shop-made enlarger is being adjusted for use in the laboratory.

or a group gathering. As the pictures are taken under a variety of conditions, the students are forced to make rapid timing and lighting judgments to get results.

Chem Lab Becomes Photo Studio

The laboratory procedure for the class in photography required a little make-shifting. Since the previous dark room would accommodate only three or four students at a time, the chemistry lecture room was turned into a dark room. It was made sufficiently light-tight for contact printing by affixing wood strips down the sides of the window frames to make a slot in which the curtains can slide.

The demonstration desk was enlarged by placing a second table in front of it on which six shop-made contact print boxes and a dark room light were placed. At each end of this table, typing tables accommodated the developing solutions. Since the photographers used the solutions in common, it was necessary to learn how to be neat enough to avoid spoiling the other fellow's picture. A small dark room off the chemistry laboratory was reserved for enlargers; another off the physics laboratory was utilized as a film developing room. Elsewhere in the chemistry laboratory photofloods and a back drop completed the studio set-up. Each student kept materials in his own chemistry laboratory drawer. Photograph tinting, drying of prints, and preparing notebooks also took place in the chemistry laboratory. Students made their own solutions from the supply shelves and since most of the group had not studied chemistry this was a good learning experience.

THE HOBBY idea has purposely been carried over to make a workshop type of class. Many different activities go on at the same time: a student is brought in to "sit" for a yearbook photo; the camera and tripod are set up in a classroom to "shoot" a particular class activity; some go outside to take pictures, while others develop yesterday's work or make enlargements. Our shelf of reference books is in constant use. No basic text was used but we plan to have one next year.

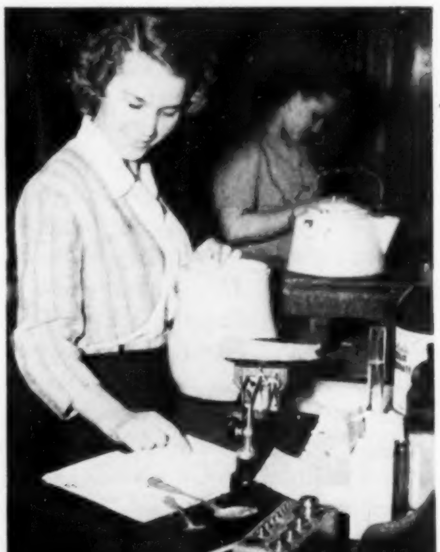
Since each student is entirely on his own, he can progress as fast as he desires or his ability allows. Two or three members of the photographic class had previous experience and were able to get started at once on picture taking and enlarging for the yearbook. They supplied incentive to the rest of the class, which longed to handle the new equipment. When students show they know how to take care of the equipment they are allowed to check it out over night or for the week-end.

Future Plans for Club and Class

In its three years of growth the club has acquired equipment valued at 650 dollars of

Continued on Page 140

Students are busy preparing solutions for use in developing and fixing films and pictures.



Chats With Science Teachers III

Science in the Bible

HANOR A. WEBB

Secretary, National Science Teachers Association
George Peabody College for Teachers
Nashville, Tennessee

Given: a book that is more widely distributed than any other in the homes of our nation, that receives the earnest scrutiny of countless young scholars in their religious study, and that is spoken of respectfully even by most of those who haven't read it. Would such a book have value to a science teacher?

That book, *The Bible*, is indeed rich in references to natural science. Granting that it cannot serve as a text for technical matters, it nevertheless can stimulate great interest and teach many worthwhile lessons in a science class. No quarrel over theologies can take away *The Bible's* position as a literary classic. The science teacher welcomes the mention of scientific facts in all good literature, even though the "license" of the poet, the philosopher, or the prophet may dress the thought in figurative expression.

WHAT CAN the science student find in *The Bible?* Well, there are *beasts* in the Book.

> Behold now behemoth . . . he eateth grass as an ox . . . he moveth his tail like a cedar . . . his bones are like bars of iron . . . he lieth in the covert of the reed and fens . . . behold, he drinketh up a river, and hasteth not . . . (Job 40:5-15).

We wonder whether Job, who was being quizzed, recognized the beast as a hippopotamus?

It is not surprising that sheep lead the list of mentioned beasts in *The Bible*, there being 512 references (by reasonably careful count) to rams, ewes, lambs, and merely sheep. Many kinds of domestic cattle are described, there being some 650 comments concerning oxen, bulls and cows, camels, asses, and horses. Goats are mentioned 99 times, and "unclean" swine, 19 times.

Dogs are always referred to unfavorably in *The Bible* as scavengers, eaters of filth, menaces to safety. They were not loved by the people of Palestine, nor cared for in the homes. Dogs had not won their way into the hearts of hunters, nor the companionship of children. It would be interesting to give information as to the domestic status of cats in these homes and hearts—but cats are not mentioned a single time in the Scriptures! Lions are mentioned 152 times—but tigers are ignored! Would not the biology student be interested in checking the other creatures—from apes to zebras—as to the Biblical interest in them?

AS THE MANY references to *birds* are noted, it should be remembered that the sober translators of the King James version of *The Bible* constantly set down simple names for the poetic allusions of the Hebrew writers to "the feathered ones" or "those with swift wings". Practically every bird specifically mentioned in *The Bible*, therefore, flies across the British Isles or nearby Europe some time during the year, but few of them cross Palestine.

There is a careful division of the feathered ones into "clean" and "unclean" lists, according to the dietary taboos of the Hebrews. It seems odd that the hen is mentioned but twice, and then as a protector of her brood, and not as a source of eggs to eat, or as a tempting dish herself. There is a strange admonition in Leviticus that—

> . . . all fowls that creep, going upon all fours, shall be an abomination to you (Leviticus 11:20).

You should avoid an argument with any literal-minded theologian, however, as to whether there were four-footed birds in Palestine in Moses' day.

When the children of Israel hungered in the wilderness they cried—

> We remember the fish which we did eat in Egypt freely . . . the onions, and the garlic (Numbers 11:5).

And because *fish* were promised to Noah and his descendents forever, fish is a staple diet and fishing an earnest business to this day in Palestine. Fish were both "clean" and "unclean", the possession of fins and scales being the favorable sign. The Fish Gate of Jerusalem is mentioned several times as a place of sales. Strangely, no specific kind of fish is ever named in *The Bible*, and not even

Continued on Page 140

Home Made Equipment in Teaching General Science

LOUIS T. COX

State Teachers College
Towson, Maryland

(Concluded from the April issue)

II. Light

IN THE study of light, any child can make a color wheel. Cut a circle of cardboard ten inches in diameter. Paste to this three equal segments of bright blue, red and yellow construction paper. To spin the wheel, glue or bolt it to a long nail or bolt. Turn it with a hand drill to see the blendings of the colors into a gray-white.

More color demonstrations related to camera filters, color photography, etc., are performed using colored cellophane and construction paper. Use the cellophane around the light source or in a projector slide. The weird color transformations of the colored construction papers in the light filtered through red, green and yellow cellophane is very effective.

A demonstration of refraction that can be left set up in the room as long as needed requires a rectangular aquarium, marbles and a small bottle or jar with mouth large enough to admit a marble. Fill the aquarium full of water, place the bottle or jar on the bottom in the very center. The sides and back should be covered with paper so the only view is through the front. Directions are: place one eye at the front corner of the aquarium, look at the bottle on the bottom, and try to drop a marble into it—no fair peeping in the top!

THE PIN-HOLE camera is an old story, but why not make one with a lens after a little work on refraction and lenses? Use pieces of wood about three inches square and one-half inch thick for the lens board and film board. Bore a ¾ inch hole in the center of the lens board. Tack a 10 cent store magnifying glass and a two inch square of cardboard with a ¼ inch round hole in its center behind the hole in the lens board. The film is to be tacked to the film board after cutting the right length from a roll in a dark room. The film must be held in exactly the place where the lens focuses the images of objects 10 to 15 feet away, so measure this distance carefully. Cut and fold a four sided cardboard box to allow this distance and tack its front end to the lens board. Into its rear end, the film board is made to fit closely. Use your hand for the shutter with the box on a steady base for time exposures—or devise a cardboard shutter, operated by gravity or a spring, on the front of the lens board, for snapshots. Finish the camera with a coat of flat black paint inside and out for best results, and seal it against light with gummed paper tape.

A 100 to 200 power microscope is next on the list. Materials needed are a pen light type flashlight bulb, a linen counter magnifying glass, a cardboard tube of about one inch diameter and 6 to 10 inches long, a small mirror, and scraps of wood. With a pair of pliers, break the glass away from the lens that is contained in the pen light bulb. Mount this over a tiny nail hole in a disc of cardboard by surrounding it in a ring of modeling clay. Cement this disc to one end of the tube as the objective lens. Similarly, mount the linen counter glass on a ¼ inch hole in a disc of cardboard for the eyepiece. After lining the tube with black paper or painting it black inside, cement the eyepiece on the other end. The mount for this microscope will depend on the materials at hand, but the slide tube is easily made by splitting and spreading slightly a two inch length of the same cardboard tubing. Tack and cement this tube to the upright frame, formed of whatever wood is available. The stage is made of wood, about three inches square by a half inch thick with a one inch hole directly below the microscope. The mirror is clamped in a brace made of tin can stock that be bent easily to direct the light from the source as desired. The stage and mirror brace are nailed to the frame. Finish the assembly with a coat of flat black paint.

III. Energy and Power

THE RELATIONSHIPS between depth of water, head, pressure and volume of water in hydraulic power stations are shown by use

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Nature Riddles

EDITH F. MILLER

Public Schools, West Caldwell, New Jersey

A sixth grade nature club became so interested in guessing the answers to nature riddles that they invited the entire class to join in the fun. Later the activity was extended so that the whole school could participate. The project has been carried on for four years with little lessening of enthusiasm.

Early in the fall a Nature Riddle Contest is announced and upper grade pupils are invited to participate. Each Monday morning a new specimen is placed on a table in a well-lighted section in the hall. Specimens which might wilt are placed in vases and replaced during the week if necessary. A small cellophane box, the kind used for powder puffs or artificial flowers, serves to hold small specimens which might otherwise roll off the table. A wide variety of specimens is possible. In the spring and fall, seeds, berries, flowers, leaves and various forms of insect life are popular. In the winter, rocks, twigs, shells, cocoons, birds' nests, evergreens, and the like will be brought. Alert pupils will find unusual specimens—a pheasant's feather, a turtle shell or a snake skin are among the possibilities.

On the table with the specimens will be a small "memo" pad, a pencil fastened to a string firmly tacked to the table, and appropriate reference books. There is also a box with a slit on the top. The box bears the following message: "If you know what the specimen is, write its name and your name on a sheet of pad paper and put the paper in this box. Don't guess! Use the books to help you."

Then there is the riddle written on looseleaf paper. A sample riddle follows:

Riddle: "These black berries grew on a cultivated vine. During the summer, fragrant trumpet-shaped flowers bloomed on the vine. The flowers were cream colored. After the flowers died, green berries formed. Later they turned black. In the winter, the birds eat the berries. The birds also use the vine as a shelter in the winter and a nesting place in summer. What vine is it?"

The following week the answer and the names of the winners are put on the bottom of the riddle sheet. Each Friday afternoon two pupils of the sponsoring class attend to this, picking out the correct and correctly spelled answers. The sheet is then placed in a looseleaf book so that all the riddles, answers, and winners' names may be permanently filed. The new riddle is then tacked to the table.

At the end of the year the names of pupils having the greatest number of correct answers may be announced.

Who write the riddles and bring in the specimens? There are many ways of deciding this. After the sponsoring class has written a few sample riddles as a group, each child in the class may be assigned to bring in one specimen that will keep indefinitely and to write a riddle about it. In this way a reserve supply is built up so that when other activities are pressing the nature contest will still go on. For awhile in the fall when interest is high, each Monday morning a new specimen may be brought in and the riddle written as a group exercise. If this is done, care must be taken that no one actually mentions the name of the specimen. Those who know what it is will contribute facts such as, "It is a cultivated plant. It is an annual." After a few weeks of this kind of procedure the riddles and specimens may be cared for by volunteers. Later the nature club may undertake to keep the work going while the teacher gives new interest to the venture by supplying a few surprise specimens and riddles from time to time.

Besides arousing an interest in nature the riddle writing furnishes a real opportunity for training in accurate observation and scientific description. It is surprising to see how many terms with which the children become familiar by means of the riddles. Words, such as perennial, biennial, stamens, antennae, nodes, alternate, igneous, deciduous, hardwood, migratory, reptile and many others, become an integral part of the vocabulary.

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How One Teacher Does It

Some Techniques Presented by Dr. Paul Brandwein

1. Is CO_2 absorbed by green plants in light? Of course it is. But how does one set up a learning situation? Or an experiment? A small amount of a dilute solution of brom thymol blue (.1%) is added to a beaker of aquarium water to turn it just blue. Then CO_2 is blown in from a generator (or from the breath) and the brom thymol blue will turn yellow.

Now place some *Elodea* (or any thriving green water plant) in a test tube and close with a rubber stopper. Place in strong sunlight. The green plant absorbs the CO_2 and the water turns back to blue. Don't forget the control—brom thymol blue turned yellow without the plant. The tube will remain yellow while the experimental tube will turn blue.

2. Do you want to strike a blow for scientific method? Then don't accept any conclusions given by the class for the experiment described above. Accept their conclusions when your class has insisted on a good number of experimental tubes (6-10) and a few controls. One swallow does not a summer make. One result does not a conclusion make. One set-up and one control does not an experiment make.

3. Two bouillon cubes in 50 cc. of water and two grams of agar make a fair nutrient broth.

4. Take two feet of ordinary clothes line. Fray the center so that you now have one section of rope connected with the other by strands of frayed rope. What do you have? Two blood vessels, one arteriole connected with a venule by a capillary bed (the frayed center of the rope). Stain one-half of it with blue ink, the other half with red, and you have a simple but efficient visual aid.

5. Have you tried bubbling carbon dioxide into a few cubic centimeters of defibrinated blood? The blood turns a deep maroon. Then oxygen bubbled into it turns it a brilliant red. People who have seen the demonstration are convinced that the bubbles which fill the long test tube (containing a few c.c. of blood at the bottom) look just like an enlarged view of a group of alveoli.

6. Have you collected jewel-weed this fall? Preserve the cut stems in 70 per cent alcohol. The epidermis strips easily, has excellent guard cells. The stem cut in thin longitudinal sections shows fine specially thickened xylem cells, among others.

Are you on the hunt for club projects, class projects, or experimental devices? What do you want to demonstrate? Write me. I may be able to find the one you want. Or have you one you want to pass on to others?

Paul F. Brandwein
Chairman, Science
Forest Hills High School
Forest Hills, New York.

NATURE RIDDLES

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If the teachers of classes which are participating in the contest will cooperate by giving their pupils a little training in riddle solving before the contest begins, better results will be assured. The children should be shown how to check their answers with each of the statements in the riddle, not with just one. Thus the specimen, dogwood berries, could not be called "bittersweet" because that answer would not correctly check with the statement. "These berries grew on a tree which had large white flowers in the spring." A little practice in individual classrooms helps the pupils to take part in the contest without becoming discouraged by too many failures. One resourceful third grade teacher made a copy of the riddle each week and placed it on the classroom library table surrounded by books or sets of pictures which the children could study at leisure. Because of her cooperation her pupils did better in the contest than some of the upper grade pupils for whom the contest was planned.

JOINT MEETING

Continued from Page 109

Study Society; Miss Ruth Dodge, 490 Broadway, Dobbs Ferry, New York, for the National Association of Biology Teachers; and Robert H. Carleton, Executive Secretary, 1201 Sixteenth Street, N. W., Washington 6, D. C.

News and Announcements

CLEVELAND MEETING

A quorum of officers and directors of the National Science Teachers Association met in Cleveland, Ohio, July 3-5, 1948. President Morris Meister presided at four meetings. Among the many items considered the following were of chief significance:

Report of the treasurer, showing an income of $20,843.62 and an expenditure of $18,-325.91 between June 1, 1947, and May 31, 1948, with a balance of $6,428.82.

Adoption of a budget of $40,000 for 1948-1949.

Report of the membership chairman, showing 3,617 paid members on June 15, 1948.

Report on affiliated organizations of science teachers, numbering 36.

Report on the activities of the Advisory Committee on Industry-Science Teaching Relations, which had held two meetings and is formulating N.S.T.A. projects and their support.

Report on the Packet Service, which is expanding under the plans and efforts of Miss Bertha E. Slye of the Headquarters Office in Washington.

Study of bulletins scheduled for fall publication: (a) "Safety Through Elementary Science," by Anna E. Burgess, Norman R. D. Jones, and Emil Massey; (b) "Science Teaching in the Schools of New York State," by Paul Brandwein and others; (c) "The Work Week of the Science Teacher," by Earl R. Glenn and Harold E. Wise.

Report of the editor of *The Science Teacher*, official journal of the National Science Teachers Association.

Plans for the Washington meeting, December 27-30, 1948, developed by R. W. Lefler and others.

The chief resolutions adopted (a) expressed appreciation for the interest of many industrial firms in the problems of science teaching; (b) endorsement of Federal aid to education; (c) urging the establishment of a National Science Foundation, with suitable provisions for scholarships and fellowships; (d) recommending a Federal fund to equalize offerings in science on the high school level, to discover youthful talent in science; (e) encouraging the activities of Junior Academies of Science, Junior Scientists' Assemblies, Talent Searches both National and State; Science Fairs, and all similar activities that discover and develop interest and skills in science on the part of young people; (f) urging that existing and potential scientists who may be inducted into military service be offered an effective program of training that will take advantage of their talents and interests.

NEW ENGLAND TEACHERS MEET

The New England Association of Chemistry Teachers held its ninth Summer Conference August 18th to the 23rd at Wellesley College, enjoying many recreational features as well as instructional programs. One symposium dealt with the "Development of Atomic Structure"; another was on Selected Topics from "Introductory Chemistry." Teachers from other sections are welcome. So plan for the next conference next summer. An announcement will be made later.

NEW APPARATUS

A much simplified new type of spectrometer that is direct reading and eliminates the need for formulas is offered by the W. M. Welch Manufacturing Company. Accuracy is 20 angstroms; "D" lines may be resolved. It is especially suited to student and research workers who need to make many determinations in a minimum of time.

Mock-ups in radio study during the last war has led to the design of a new Radio Demonstration Panel by the W. M. Welch Science Company. Parts are mounted on the front, with appropriate symbol; circuit lines are on the front—wires on the back. Inspection is simple. It works.

Have you seen the February, 1948 issue of *Education* (published by Palmer Company, Boston)? The whole issue is devoted to the single topic of "Workshops in Science Education". It contains over 12 different articles,

all edited by Dr. Hanor A. Webb of Peabody College for Teachers and the secretary of N.S.T.A.

WRITE FOR IT

For material on preventing forest, woods, and range fires (posters, booklets, aids, etc.) write to the state forester or commissioner of conservation of your state. Also write the local chapter of the Red Cross. A regional forester of the United States Forest Service may be reached at any of the following places: Missoula, Montana; Albuquerque, New Mexico; San Francisco, California; Philadelphia, Pennsylvania; Milwaukee, Wisconsin; Denver, Colorado; Ogden, Utah; Portland, Oregon; Atlanta, Georgia.

Educational comic books may be obtained from the General Electric Company, Department 6-318, Schenectady, New York, in quantity for class needs. The following are available:

The Generation of Electricity (GEC-174), *Uses of Electricity* (APG-17), *Distribution of Electricity* (APG-17-1), *X-Rays in Medicine, Industry, and Science* (APG-17-3), *Electricity in Railroading* (APG-17-4), *Johnny Goes to Williamsburg* (APG-17-6) (compares older with modern conveniences), *Adventures in Jet Propulsion* (APG-17-2), and *Adventures Inside the Atom* (APG-17-5).

A revised edition of the booklet No. B-3986, *Motion Pictures and Slide Films for School Use*, listing a number of new films rent free, is now available from School Service, Westinghouse Electric Corporation, 306 Fourth Avenue, Pittsburgh 30, Pennsylvania.

From the Standard Oil Company, 30 Rockefeller Plaza, New York 20, New York, you may obtain in quantity the following:

Gasoline by Synthesis, A 22 page pamphlet which explains graphically the American modification of the Fischer-Tropsch process and its possibilities.

Rubber from Oil, A 24 page booklet dealing with some phases of research, process design, and resulting products.

Natural Gas, A 20 page booklet giving the facts about natural gas and its future prospects as a fuel.

Conservation: Making the Most of Our Oil, A 20 page booklet describing the efforts of the petroleum industry to conserve future oil supplies by scientific methods designed to assure maximum recovery.

The Amazing Story of 16mm Sound Motion Pictures. This is a 16 page booklet in color, beautifully illustrated, telling how sound movies are made, how the illusion of motion is created, how sound is recorded on film and how sound is reproduced from film. Ten cents per copy. Ampro Corporation, 2835 North Western Avenue, Chicago 18, Illinois.

Home Freezing of Fruits and Vegetables. A 24-page booklet giving step-by-step directions and latest techniques for processing the principal fruits and vegetables. Obtained from the American Sugar Refining Company, 120 Wall Street, New York 5, New York.

Atomic Artillery. A 14-page reprint from the General Electric Review. Illustrated. Gives principles and mechanisms of electron and ion accelerators, including cyclotron, betatron, and synchrotron. Write to General Electric Company, Schenectady, New York.

Friends of the Land is a non-profit society for the conservation of soil, rain and man. You can become an active member and receive the magazine by sending $5.00 to the society at One South Fourth St., Columbus 15, Ohio.

Herpetologica is a magazine dealing exclusively with reptiles and amphibians. A subscription and a membership in the Herptologists League can be had for $3.00 by writing to the editor, Chapman Grant, 2970 Sixth Avenue, San Diego 3, California.

Texas Cancer Bulletin. A 72 page journal dealing with causes, detection, diagnosis, and treatment of cancer. Three dollars per year; 75 cents for one copy. Published bi-monthly at Houston, Texas. Sponsored by a number of medical and research organizations in Texas. Among the contents of the May-June issue are: *Gastric Cancer, Cancer Information Centers, Forty Ways to Prevent Cancer, When is Radiotherapy Indicated, Mouth Cancer, Nitrogen Mustard, Cervial Carcinoma and Pregnancy, Ulcerative Collitis and Cancer of the Colon, Terminal Care, Tumor Topics.*

LLOYD WILLIAM TAYLOR

Dr. Lloyd W. Taylor's many friends will be grieved to learn of his untimely and tragic death which occurred August 8 while climbing on Mt. St. Helens with members of his family.

Dr. Taylor belonged to N.S.T.A. and was a member of its board of directors. He was a member of the A.A.A.S.; the Ohio Academy of Science and the American Association of Physics Teachers of which he was president in 1943. He was on the governing board of the American Institute of Physics from 1944 to 1947. He was distinguished by membership in both Phi Beta Kappa and Sigma Xi.

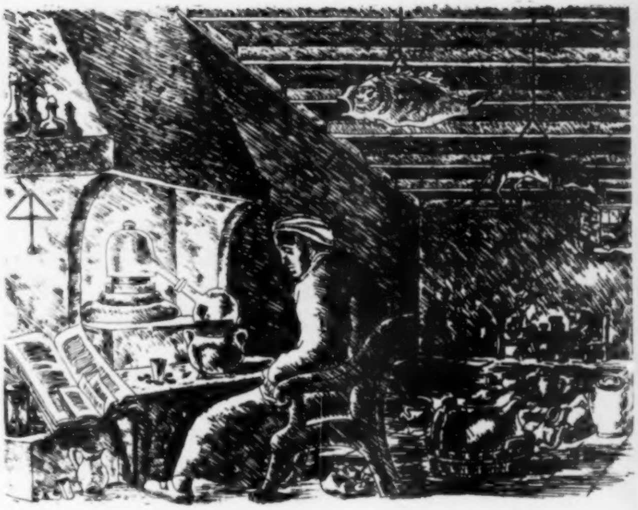
Lloyd Taylor was a graduate of Grinnell College in Iowa. He completed his doctorate at the University of Chicago in 1922. After serving as an instructor on the staff of the physics department of the University of Chicago for two years, he went to Oberlin College in 1924, where he was a professor and head of the department of physics to the time of his death.

Dr. Taylor has been the author or co-author of several books in the field of physics. Best known among these is probably his *Physics, the Pioneer Science* with its rich background of the historical development of physics and its multitude of excerpts from original manuscripts.

Dr. Taylor's keen interest in the problems of science education was indicated by his participation in the work of the American Association of Physics Teachers as chairman of the committee on the Teaching of Physics and Physical Sciences in the Secondary Schools and by his active membership on the A.A.A.S. Cooperative Committee on the Teaching of Science and Mathematics.

Lloyd Taylor will be missed by his students and colleagues who will remember him as being devoted to the task of raising the level of knowledge and human goodness among our people.

Report of the National Committee on Policies in Conservation Education. A 9-page pamphlet, published February 1, 1948, is available at ten cents a copy from Dr. John W. Scott, 1409 Garfield, Laramie, Wyoming.



The alchemist at work in his laboratory as here shown is taken from theinscribed medallion of the Fisher Award in Analytical Chemistry.

FISHER AWARD

The Fisher Award in Analytical Chemistry, the highest honor that can be conferred in the field of analytical chemistry, was presented to Dr. N. Howell Furman, Professor of Chemistry at Princeton University and a consultant to the United States Atomic Energy Commission. He is the first to receive the award, consisting of a prize of $1,000 and an inscribed medallion that is here shown. The award bears the name of C. G. Fisher of the Fisher Scientific Company who first offered to finance it when the need for the award was considered.

Professor Furman, a former officer of the American Chemical Society and editor of its journals since 1936, is widely known as an author in the sphere of analytical chemistry, both for many published articles and a much used text in quantitative analysis. He is editor-in-chief of *Scott's Standard Methods*, the analyst's standard reference. His contributions have been outstanding, especially in the development of electrometric techniques in chemical analysis, notably potentiometric titrations. He has developed a technique of oxidation using cerium salts as applied to analytical chemistry. In World War II he played a major role in the development of an ether extraction process for the preparation of uranium oxide as discussed in the Smyth report on atomic energy.

SOME LECTURE DEMONSTRATIONS

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and was presented at the symposium on "Lecture Demonstrations" given by the Division of Chemical Education of the A.C.S. at New York last fall. It consists of two 500 ml round bottom flasks sealed neck to neck with a depression in the top side of one or both of them. The system is evacuated and one of the flasks contains a little water. When a Dry Ice-acetone mixture is placed in the depression of the opposite flask, the water may boil under the reduced pressure and eventually freeze. This presents the entry for a discussion of heat of fusion. If the amateur glass blower undertakes the construction of the apparatus, thorough annealing is recommended.

7. The oxidation of ammonia has been frequently described. One of the simplest ways to demonstrate it is to place some concentrated ammonia solution in a beaker and bubble oxygen through it (Fig. 5). A platinum spiral heated to redness is introduced into the mixture of gases above the liquid and continues to glow as they combine at the surface. If the flow of oxygen is increased sufficiently, a series of explosions takes place and the mixed gases burn at the mouth of the beaker. After the spiral has been used several times the surface becomes rough and the preheating is not necessary.

Fig. 5. A red-hot platinum spiral continues to glow when placed in a mixture of oxygen and ammonia gas.

8. A substance which is not as common in most laboratories as it should be is porous barium oxide[4].

It is a desiccant equal in power to phosphorous pentoxide and it is much easier to handle. Its affinity for water is easily demonstrated by placing a shallow layer in the bottom of a beaker and adding water (Fig. 6).

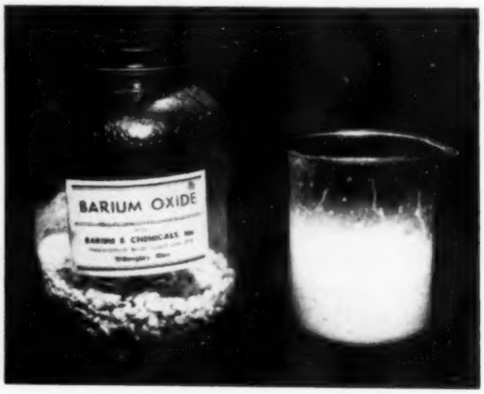

Fig. 6. The heat of hydration of barium oxide is sufficient to boil water.

The heat of hydration is sufficient to heat several times its volume of water to boiling and on cooling the entire mass solidifies as the hydrate. This reaction serves to illustrate a simple chemical reaction, heat of hydration, and water of crystallization.

9. Ion exchange resins have taken an important place in the conditioning of water for many uses as well as in chemical processes. We make use of the apparatus described by Nachod and Sussman[5].

10. To one of my former teachers, Dr. Hippolyte Gruener of Western Reserve University, I am indebted for the simplest demonstration of the combination of oxygen and hydrogen. The gases are introduced into a suitable container such as a football bladder and subsequently discharged under the surface of a solution of soap or better one of the modern surface active agents which forms good bubbles. A handful of these bubbles is then thrust into a flame. The effect of this action is guaranteed to wake up the most lethargic student.

4—Obtainable from Barium and Chemicals Co., Willoughby, Ohio.

5—Nachod and Sussman, *J. Chem. Ed.*, *21*, 57, (1944).

OUTLOOK IN SCIENCE EDUCATION

Continued from Page 107

project work are to some degree homogeneous in ability and interest. Furthermore, these activities provide an opportunity for both teacher and pupil to work with apparatus on an experimental basis. After-school work in science usually catches the essence of the scientific method; it deals with natural phenomena, not verbalisms; purposeful experiences, not artificialities. It is somewhat tragic to note that life for these teachers begins at 3 P. M. But the sad fact is that there are too few of these teachers. Time and post-war conditions have taken many of them out of the science classrooms. The flow of replacements has dwindled to a mere trickle. We must face with realism and determination a situation in which, in the main, science is being taught today by teachers who are poorly trained in science. This, at a time when the need for good science teachers has never been greater. This, at a time when we know that the greatest peak in secondary school population will be with us in about five or six years.

However, two rays of sunshine are appearing through the clouds. One is the much hoped for and almost realized Federal Aid to Education Bill. If it comes, it will change the educational scene with a burst of energy that may equalize educational opportunity throughout the land, releasing human intelligence and talent. Out of this can come, in a single generation, the kind of mass support for education which is irresistible in our kind of democracy.

The second ray of sunshine emanates from the National Science Foundation. This may come even sooner than the Federal Aid Bill. N.S.T.A. can be proud of the fact that it has lent its support to both legislative efforts. N.S.T.A. and its science teachers will be among the chief beneficiaries. Above all else, the National Science Foundation—if and when it is established—will replenish the sadly depleted supply of scientific personnel, without which all of its efforts are bound to fail. To do this, the first order of business must necessarily be good science teachers—science teachers for the elementary school, the junior high school, the senior high school, the junior college, the senior college and the teacher training institutions.

Also—if an adequate supply of scientific personnel is to become available for exploring and solving the infinite variety of fascinating problems that nuclear science has opened up—it is essential that we identify early the potential science talent. This can not be done without a planned program of science instruction that will broaden the base from which the talent will come. It means a program of science from kindergarten to college; and with it a complete arsenal of instruments of selection and techniques of guidance.

This, ladies and gentlemen, is a most pleasing outlook in science education. It lifts the spirit of those who have faith in science as the modest servant of people; in science as the builder of civilization and the "solver" of human problems; in science as the hope for permanent peace in a free democracy.

SCIENCE IS FUN

Continued from Page 119

were asking questions containing such words as "sympathetic vibration", "resonance", "frequency", "amplitude", "pitch", "quality", "wave-length", "longitudinal", and "transverse". Some, indeed, were offering vignettes of experience in which these words were somehow involved.

"Tomorrow," the students are promised, "you are to see a motion picture which will give you a much better concept of the nature of sound waves and how they are produced." A little flurry of approbation passes through the room.

NEXT DAY the instructor appears before the class with a bundle of mimeographed sheets. The students recognize them of old. They are "*study sheets*", and a copy is given each student.

On these sheets appear two divisions of material. First, there are five or six statements labeled, "Points for which you should watch". These points give the student the main ideas of the film. Second, there is a list of words labeled, "Words you will hear used". These are all words which are apt to be unfamiliar to the student. The class reads the sheets over together and aloud so as to be sure that all words are recognized, and to get the poor reader or non-reader into the session.

After this comes the actual showing of the film "Sound Waves and Their Sources". Even Susie Simplect is interested. The man in the picture is using scientific words and she feels that somehow they are old acquaintances—well, acquaintances, anyway.

When the lights go on again at the end of the film, there is a flurry as the "study sheets" are brought out again. It is quite a game to see who has caught the *main points* and the words used. Students ask and answer questions about the film. They may tell what they like or dislike about the film. If time permits, the film may be shown again to clear up points around which an argument may have developed.

THIS IS the time to suggest that perhaps the text-book or some reference book may have something to say on the subject. Even the non-readers open their books and look at the pictures. The instructor suggests that there is an interesting article on ultrasonics in a recent issue of a magazine to be found in the library. Within a few days, an interested student presents a short report on the article. Another may start work on a project in which he has become interested. Still another may prepare a little demonstration of his own for the class.

Meanwhile, students are confronted with the fact that there are problems in sound control. The halls of the building are finished in hard plaster, and the noise thence is a revelation to the uninitiated.

"There are ways of handling sound waves, and there is a fairly good treatment of it in a film called *Fundamentals of Acoustics*", the students are advised. "We shall have a look at it and see what we can learn about the subject."

The same general plan of presentation is again followed with this film. The topic of sound is brought to a conclusion with a fairly comprehensive test.

The foregoing represents in broad general outline the method employed in the use of all our films in general science. Sometimes the students themselves do the demonstrations rather than the teacher. Occasionally the whole class will go to the physics laboratory to carry out simple experiments. In some instances, slides and filmstrips can be employed to excellent advantage.

IN AN ATTEMPT to evaluate the worth of this type of program in which the text-book plays a minor role, the writer and a colleague experimented with four unselected general science groups.

Two classes, A and B, were taken through the regular text-book work on the astronomy and physiography units. Two other classes, C and D, during this same time studied an entirely unrelated subject.

After two weeks, we began showing a series of motion pictures on the subjects of astronomy and, later, physiography. All four classes

were given the same "study sheet" preparation by the same instructor as the films came along. Classes A and B continued these unit studies in the text-book. Classes C and D continued with an unrelated subject.

The films used in these series were as follow and in this order: *Exploring the Universe, The Solar Family, The Earth in Motion, The Moon, The Earth's Rocky Crust, Volcanoes in Action, Mountain Building, The Wearing Away of the Land, Geological Work of Ice, The Work of Running Water, The Work of Rivers, Ground Water*, and *The Work of the Atmosphere.*

Those familiar with these films will recognize the sequence as dealing with such phases of astronomy and physiography as are treated in most general science text-books.

AT THE conclusion of the series the same comprehensive tests were given all four classes. Analysis of the test grades failed to show any measurable difference between the scores of classes A and B on the one hand and classes C and D on the other. Classes A and B had spent a total of about nine weeks studying the material, using the text-books in the classical manner. Classes C and D had used the text-book hardly at all.

While these results are far from conclusive, yet they do afford some grounds for raising a question as to whether we are not wasting a lot of valuable time and effort. Perhaps we are pushing general science students through a maze of printed material when we might more effectively be using direct audio-visual methods.

DEMONSTRATING PHYSICS

Continued from Page 113

or five dozen traps are assembled on this card table, in no regular fashion, and they are covered with a wire screen to keep the flying neutrons somewhere in the neighborhood. Here is a large amount of "atomic energy" ready to be exploded by the chance entry of a neutron. Whenever fission takes place in uranium 235, or plutonium, by the impact of a neutron, more neutrons are set free. Then if there are enough fissionable atoms in the vicinity, a chain reaction may start. Chain reactions are *chance* reactions of high prob-

ability. In this model atomic bomb, the flying corks (neutrons) have a good chance of setting off additional traps (atoms of uranium), and more corks start flying about. In about two seconds, with a clatter of traps and a hail of flying corks, perhaps 75 per cent of all the traps on the table "explode" after a single cork-neutron is tossed into their midst. This experiment was shown first to the American Association of Physics Teachers last January, but like a true chain reaction it has spread across the country explosively, faster than the slow mills of scientific publication could keep up with.

Every collection of demonstration experiments must come to a close. These experiments are intended to clarify, not to mystify. Therefore, the teacher of physics, although he may use many of the techniques of the showman and the magician, must find his chief duty to *explain physics*, rather than obscure it. However, it doesn't hurt, now and then, to turn magician; for magic is often nothing but physics applied in obscure fashion, with "explanations" that don't explain at all but rather mislead. So, with my long white magician's wand, I now wave you farewell by making my wand pick two words out of the air:

"THE END".

*This is accomplished by using a lantern slide (cut card) bearing the words "The End". The projector (hidden) casts a real image of the slide in space about six feet from the lantern. The wand, rapidly waved across the spot where a white screen would show a clear image, causes the words to appear in mid-air. The lantern may be directed toward a door or side wall so that stray light is not evident. Persistence of vision makes the words easily seen.

HOMEMADE EQUIPMENT

Continued from Page 124

of a two gallon oil can and a waterwheel made from a tin can top. After removing the top from a round can with a can opener, cut 8 radial slits into within ½ inch of the center with tin shears. Twist each of the segments, thus formed, to make the paddles of a waterwheel. Drive a small brad through the center for an axle and fix it in place with a dab of modeling clay on each side at the hub. Now, in the oil can, use an ice pick to punch holes 1/3 and 2/3 the way down and several holes at the same depth on different sides near the bottom. Make one of the holes near the bottom much larger than the others. Plug all these holes with modeling clay and fill the can with water. As one plug at a time is removed, the distances water shoots out is measured and the water wheel is used as an indicator of how much work the various streams can do.

Other water wheels, of a more sturdy nature, to drive small toy machines through pulleys or cranks or as a windlass are made by tacking square tin paddles to a spool. A long nail or dowel is used for an axle and a tank and garden hose or the faucet is used for the supply of water.

How a sailboat uses the energy of the wind is best demonstrated by building and sailing a sailboat. Use a piece of wood from the end of an orange crate about 5″ x 2″ x ¾″. With a pen knife, whittle a hull. On the top side make two slits with the point of a blade and wedge tooth picks into these slits for masts. Cut two rectangular pieces of tin—one two inches square and the other one inch long and a half inch wide. Wedge these into slits under the boat—the large one in the center as a center board and the small one at the back as a rudder. Two squares of paper make the sails. Outdoors is the best place to sail our boats, but if that is not convenient, a waterproof canvas pond can be built on any table top and an electric fan will supply the breeze. How many of your children know how a sailboat goes north when the wind is blowing toward the south?

STEAM is one of our most used forms of energy, so why not build a turbine? Use an alcohol lamp for heat. Make it from a salve can. Punch two holes in the top, one with a nail to release vapor pressure and the other with something larger to admit the two inch clothesline wick. The boiler is a half pint screw top can such as is often used for metal polish. It is placed above the firebox which is part of a tin can, cut so the alcohol lamp can be placed in under the boiler and so the boiler is held at the right height above the flame. The nozzle is a small nail hole punched from inside the screw cap. The rotor is similar to the water wheel made from a tin can top, but it can be mounted in bearings of tin, soldered to the top of the boiler so that the rotor blades must turn past the nozzle. Use medicine droppers to put alcohol in the lamp and water in the boiler.

To show some of the principles of the gasoline engine, a coffee or paint can are the only equipment needed. Punch a large nail hole in the side near the bottom and another one near the top. Into the top hole, use an eye dropper to place one or two drops of gasoline. After a few seconds touch a lighted match to one of the holes. You may have to experiment to find the number of drops and time lapse to use for the best explosive mixture with the can you use. Be sure to burn some gasoline in the can lid, unconfined. Stress the safety and power implications of the confined explosive mixture!

If you are interested in other materials of this type in these and other areas, be sure to see

Lynde, C. J., *Science Experiences with Home Equipment* and *Science Experiences with Inexpensive Equipment.*

Morgan, A., *Things A Boy Can Do With Electricity* and *First Radio Book for Boys.*

Teaching Aids. A booklet listing the many free or inexpensive helps for teachers of science and related subjects. It lists booklets, posters, charts, film and slide film. Write to School Service, Westinghouse Electric Corporation, 306 Fourth Avenue, Pittsburgh, Pennsylvania.

CLUB HOBBIES

Continued from Page 122

which 410 dollars is paid. Next year should see the loan completely repaid. If funds permit, another enlarger will be purchased; a print washer and other items will follow. The club carries insurance against theft and breakage so we need not have a serious setback from this source.

Next year the school is providing more cupboard space for storing equipment and a small booth for film tank loading. It will continue to supply the solution chemicals.

The club, thus far concerned with money making, is looking forward to achieving a greater degree of democratic planning and control, evening meetings of better quality, and a greater activity on the part of each member.

There will be a somewhat larger group in the photography class next year. It will be divided into three groups: contact printing, developing, and yearbook pictures. By rotating the work our limited dark room space will suffice.

SCIENCE IN THE BIBLE

Continued from Page 123

in the original Hebrew writings. The methods of catching fish—by hooks, spearing, nets—are often described, but usually as warnings to "poor fish" of the human family not to get caught by evil.

FISH are the central figures of four miracles of Jesus. The Final Judgment is not only to be a separation of "sheep" from "goats", but also "good fish" from "bad fish" (Matthew 13:48). The most frequently-told story of the Old Testament is probably that of the "great fish" that swallowed Jonah (Jonah 1:17), which tale-tellers persist in calling "a whale" without the slightest Scriptural warrant!

(Concluded in the December issue)

BOOK SHELF

STUDENTS HANDBOOK OF SCIENCE. Bernard Udane and Herman W. Gillary, Science Department, Forest Hills High School, New York City. Frederick Ungar Publishing Company, New York, 1948. 208 pp. Paper cover. $.75 net.

For every student of science, particularly at the high school level, this *Student's Hand Book of Science* performs a very important service in helping him to discover his abilities and to find his special interests. It deals with such important problems as "choosing a career, qualifying for a scholarship, starting a science hobby, preparing a written or oral report, keeping a good science notebook, and many others."

Clearly the book comes from the experience of science teachers in answering the questions of students concerned with both the present and the future. It should serve to increase the number who elect additional work in science at college and perhaps follow some phase of it as a career. At a time when our trained personnel in science is woefully deficient, such a book is most welcome.—J. C.

CHEMISTRY GUIDE AND LABORATORY EXERCISES. Martin V. McGill, Howe Military Academy, Howe, Indiana; and G. M. Bradbury, Montclair High School, Montclair, New Jersey. Lyons and Carnahan, Chicago, 1948. 378 pp. Illus.

The latest revision of *Chemistry and Laboratory Exercises* retains the many earlier good features, including the mastery unit organization, student guidance in the learning process, emphasis on chemical principles and their relation to practical situations, and practice in using problem solving technique. In addition it has been brought up to date in guiding the student to some knowledge of atomic energy.

New practice materials have been introduced that are suitable for either the gaining of new understandings or the mastery of manipulative skills. References are included for the new classroom texts.

The book will no doubt retain its standing as one of the best sellers in this field.—J. C.

BIOLOGY AND HUMAN AFFAIRS by John W. Ritchie. World Book Company, Yonkers-on-Hudson, New York, 1948. 818 pp., 15½ x 23 cm. Illustrated.

The new edition of the book covers a wide range of material organized mainly around the larger principles basic to biology. In the development of the principles, concrete studies of types and groups are carried out to remove abstractness and give the values of other methods of approach. Use of groups, as well as individual types to illustrate general ideas, helps to acquaint the student with a wider range of forms. The general aim has been to develop an understanding of the method and scope of biology and an appreciation of the importance of extending its application to human affairs.

The text is divided into nineteen units, covering in addition to the usual material, helpful units on parasitology and on behavior. The units are introduced with an appropriate, illustrated title page followed by a one-or-two-page account of the unit. Units are broken down into from three to eight problems (comparable to chapters). Each problem closes with a paragraph outlining important facts covered. At the end of each unit is a summary, a

group of comprehension questions and a suggested list of activities and applications.

The text has an accompanying workbook, and could be used as either a class text or as a desirable reference book in the science library.

PHYSICAL SCIENCE AND HUMAN VALUES. A symposium by P. W. Bridgmen, Harlow Shapley, H. N. Russell, F. T. Spaulding, F. S. C. Northrop, I. I. Rabi, Michael Polanyi, L. A. DuBridge, with a foreword by E. P. Wigner. Princeton University Press, Princeton, N. J., 1948. 181 pp. $3.00.

This publication will serve as a source of stimulation for those of us not having had the good fortune to attend the two day symposium headed by this imposing panel of top rank scientists. Each scientist in the book presents his ideas concerning a particular question regarding the relations of the various educational, scientific and governmental institutions, or the influences which the work of the scientist or of the scientist himself exerts or should exert on society. The presentation, in each case, is followed by a panel discussion.—J. S.

ESSENTIALS OF RADIO. Morris Slurzberg, Jersey City Vocational High School; William Osterheld, Wm. L. Dickinson High School, Jersey City. McGraw-Hill Book Co., New York City, 1948. 806 pp., illus. $4.00.

This textbook, written by two secondary school teachers, is designed to meet the needs of the student of radio on an intermediate level. It covers the operation of vacuum tubes and circuits in low frequency radio receiver applications. A chapter on test procedures and one on transmitters are included as introductory to these fields. The appendix of seven sections provides much practical information. Mathematics is kept to a minimum, and practical examples are given to illustrate the application of equations and principles.—J. S.

BACTERIOLOGY. Fourth Edition. Fred Wilbur Tanner, Head of the Department of Bacteriology, University of Illinois; and Fred Wilbur Tanner, Jr., Bacteriologist, Northern Regional Laboratory, U. S. Department of Agriculture, Peoria, Illinois. John Wiley and Sons, New York, 1948. 625 pp., 14 x 21 cm. 137 illus. $4.50.

As in earlier editions of *Bacteriology* this latest revision is first of all a textbook of micro-organisms and presents the fundamental facts and principles needed for a first year course in bacteriology. In addition to a revision of previous chapters, new material has been added, including a chapter on ultra-microscopic forms of life and another on variability of micro-organisms, giving various explanations of modern pleo-morphism. Pathogenic bacteria in relation to disease are discussed only as is necessary for a well rounded course in bacteriology. Full attention is given to such features as classification of bacteria, cytology of the bacterial cell, and nutrition of bacteria. Not only is the text well suited as a college text but is also desirable as a high school reference for the better students and the teacher in this field.

ATLAS OF OUTLINE DRAWINGS FOR VERTEBRATE ANATOMY. Samuel Eddy, Professor of Zoology, University of Minnesota; Clarence P. Oliver, Professor of Zoology, University of Texas; and John P. Turner, Late Assistant Professor of Zoology, University of Minnesota. John Wiley & Sons, Inc., New York, 1947. 102 illustrations, 23½ x 28½ cm. $2.00.

This book replaces the *Atlas of Outline Drawings of the Dogfish Shark, the Necturus, and the Cat for Vertebrate Anatomy*, published in 1940. The book consists entirely of well-prepared, unlabeled outline drawings of amphioxus, dogfish shark, Nectarus, cat, and the structures of the

skulls of Acipenser (sturgeon), Lepisosteus (gar), and Amia (bowfin). The drawings cover most of the important structures usually dissected in comparing the anatomies of these forms.

The outline drawings are arranged to correspond with the directions in the author's *Guide to the Study of the Anatomy of the Shark, Necturus, and the Cat.* The atlas thus offers a "workbook" to accompany the laboratory guide. However, regardless of the manual used, the outline drawings could be used in any laboratory where these animals are studied.

GUIDE TO THE STUDY OF THE ANATOMY OF THE SHARK, NECTURUS, AND THE CAT. Samuel Eddy, Professor of Zoology, University of Minnesota; Clarence P. Oliver, Professor of Zoology, University of Texas, and John P. Turner, Late Assistant Professor of Zoology, University of Minnesota. John Wiley & Sons, Inc., New York, 1947. 115 pp., 15½ x 23½ cm.

This *Anatomy*, in its second edition, is intended to serve as a guide for the student in dissecting the animals described below. It has a paper cover and is bound by means of a flat wire spiral. The book was designed primarily for a course in comparative vertebrate anatomy, covering one quarter of the University of Minnesota. The three forms studied were selected to represent the important stages in vertebrate development.

The first section of the book deals with the spiny dogfish shark. External and internal anatomical structures, exclusive of the muscles, are described, along with an account of the skeleton. The second section consists of a three-page account of the teleost fish (codfish) skull. The third section describes Necturus, the mud puppy. Following the introduction, there are divisions on the external and internal anatomy, the skeleton and the muscles of Necturus. The final section of the guide deals with the skeleton, muscles, abdominal organs, thoracic viscera, circulatory system, mouth, pharynx and ear, and the nervous system of the cat.

FUNDAMENTAL CHEMISTRY. Revised Edition. Horace G. Deming, Professor of Chemistry, University of Nebraska. John Wiley and Sons, Inc., New York City, 1947. 745 pp. 183 illus.

This text for the first year college course in chemistry stresses careful and accurate thinking. The author believes in giving much attention to those topics that have proved to be fundamental to an understanding of the subject, and less to the many and varied applications. He conceives chemistry to be a manner of thinking. Consequently *Fundamental Chemistry* provides a vivid portrayal of the principles of chemistry in this revised and rearranged book.

A chapter near the end of the book brings it up to date in recent nuclear achievements and the synthesis of new elements. Some attention is also given to such new developments as silane derivatives, inorganic complexes, sulfa drugs, and the production of antibiotics.

ALL ABOUT US. Ava Knox Evans. Capitol Publishing Co., New Yor kCity, 1947. 95 pp. Illustrations by Vana Earle. $2.00.

A clever story of people; their beginnings, their wanderings over the earth, and the changes in skin color, customs and language that resulted from separation and different environments. Building upon a foundation of scientific facts, the author, with the privilege of poetic license, reaches into the realm of comprehension of and fascination for the

young reader. The story is told with humor and simplicity. *All About Us* is for children to read themselves or to be read aloud to children. With this book, Eva Knox Evans makes a profound contribution to intercultural education. The book has a rightful place in every children's library.—J. S.

MATERIALS OF INDUSTRY. The late S. F. Mersereau. Fourth edition revised by Calvin G. Reen, Professor of Engineering Extension and Kenneth L. Holderman, Associate Professor of Engineering Extension, both at the Pennsylvania State College. McGraw-Hill Book Co., New York, 1947. 623 pp. $2.80.

This book presents important materials of industry and outlines their methods of manufacture. It includes materials of importance in recent industrial development. New material has been added, in this edition, on plywood, plastics, synthetic rubber, magnesium and light alloys, products used in modern industry. The book is replete with teaching aids and includes an index.—J. S.

THE AUTOBIOGRAPHY OF SCIENCE. Edited by Rorest Ray Moulton and Justus J. Schiffers. Doubleday, Doran and Company, Inc., Garden City, N. Y. 666 pp. 14 x 21 cm. $4.00.

This book covers the various fields of science—medicine, biology, chemistry, physics, astronomy, optics, botany, genetics, anthropology, geology, aeronautics, psychology and several related areas. It presents the material through a selection of the original papers of eminent scientists. About one hundred such selections are included. One can read the writing of Leonardo da Vinci on flight, of Newton on gravitation, and of Darwin on natural selection. Here it might be said is presented the best writing a man ever did about the best thing he ever did. This makes it possible to sense the thrill of experiencing great discoveries as they came to men in the past, just as today we are thrilled and our imaginations excited by the invention of the atomic bomb.

The book is very desirable as a library reference.

STATEMENT OF THE OWNERSHIP, MANAGEMENT, CIRCULATION, ETC., REQUIRED BY THE ACT OF CONGRESS OF AUGUST 24, 1912, AS AMENDED BY THE ACTS OF MARCH 3, 1933, AND JULY 2, 1946.

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Of *The Science Teacher*, published 4 times per year at Normal, Illinois, for October, 1948.

STATE OF ILLINOIS, County of McLean, ss.

Before me, a notary public in and for the State and county aforesaid, personally appeared John C. Chiddix, who, having been duly sworn according to law, deposes and says that he is the owner of *The Science Teacher* and that the following is, to the best of his knowledge and belief, a true statement of the ownership, management, etc., of the aforesaid publication for the date shown in the above caption, required by the Act of August 24, 1912, as amended by the Act of March 3, 1933, embodied in section 537, Postal Laws and Regulations, printed on the reverse side of this form, to-wit:

1. That the names and addresses of the publisher, editor, managing editor, and business managers are:

Publisher—John C. Chiddix, Normal, Illinois.

Editor—John C. Chiddix, Normal, Illinois.

Managing Editor—None.

Business Manager—John C. Chiddix, Normal, Illinois.

2. That the owner is: John C. Chiddix.

3. That the known bondholders, mortgagees, and other security holders owning or holding 1 per cent of total amount of bonds, mortgages, or other securities are: none.

JOHN C. CHIDDIX.

Sworn to and subscribed before me this 28th day of September, 1947.

(SEAL) (My commission expires Jan. 17, 1952).
Ethel Pace.

Repairing Your Thermometer

Undoubtedly you have had mercury thermometers in your laboratory with the mercury column divided in one or more places. With proper precautions, these thermometers may be salvaged for accurate use again. Obtain a few cents worth of Dry Ice from your local ice cream dealer. Dry Ice has a temperature of -109° F., while mercury has a freezing point of only -38° F. Slowly bring the thermometer bulb in contact with the ice, turning it as you do so. The thermometer will quickly register 0°, -10°, -20° and -30° F. About at this point you may find that the mercury will cease declining until the bulb has melted a depression for itself in the ice. Continue turning the thermometer, observing the bulb closely as you do so. Remove it from the ice as soon as the column of mercury disappears into the bulb, as the mercury will freeze solid otherwise, with the possibility of breaking the glass bulb of the thermometer. If the divided column has not reunited in all places, repeat the above procedures.

Phase Microscopy Gives Contrast

Contrast effects may be achieved by means of phase changing elements in microscopy according to Joseph Magliozzi of the Bausch and Lomb Optical Company. Phase microscopy optically utilizes the differences in the speed at which light travels through denser areas of the specimen by transforming the resulting phase shifts or differences created by the specimen's various densities into differences of brightness. Contrast is produced through coating the ring-like surface portion of the phase plate with magnesium fluoride.

Plants from other parts of the world will be introduced and thoroughly tested in areas of the United States where they offer promise as breeding material or as new crops in a Federal-State program under the Research and Marketing Act of 1946, the U. S. Department of Agriculture announced. Less than half of the world plant material that could grow here has had an opportunity to demonstrate its possibilities.